M43-1-280 HELICAL PRINTER
CONTENTS

INTRODUCTION 1
Physical Description 1
GENERAL DESCRIPTION 2
Function Code Implementation 2
Clear Printer (FCCLU) 2
Accept Data Format Character (FCFOR) 2
Accept Column Address Character (FCADS) 5
Accept Data Character (FCDTA) 5
Motor ON (FCMON) 5
Motor OFF (FCMOF) 5
Is Journal Low (FCJL) 5
Initiate (FCPRT) 5
Status Code Implementation 5
Ready With Slip (RWS) 5
Ready Without Slip (RWOS) 5
Busy (BUSY) 5
Journal Low (JL) 5
MECHANICAL DESCRIPTION 5
Printer Drive 6
Printing 6
Typewheel Inking 7
Journal Feed 7
Slip Feed 8
Auto Receipt Paper Threading 8
Receipt Feed 9
Electro Inking and Printing 9
Receipt Knife 10
Cam Line Timing 11
ELECTRICAL DESCRIPTION 12
Electronic Control 12
Internal Timing Logic 12
Function Recognition Logic 12
Status Generation Logic 13
Motor Control Logic 13
Line Feed Control Logic 13
Mechanism Control Logic 13
PLB (Print Line Buffer) 13
PLB Positioning Control Logic 13
PLB Loading Control Logic 13
Compare Logic 13
Character Generation Logic 13
Receipt Hammer Delay Counter A 13
Receipt Hammer Delay Counter B 13
Hammer Fire Control Logic 14
Partitioning of Control Logic Functions 14
Driver Circuits 14
Motor Control Circuit 14
Switch Sensing Circuits 14
Reluctance Head Amplifier Circuits 14
Mechanism Control Circuits 14
Hammer Driver Circuits 20
Hammer Bias Circuit 20
LOGIC IMPLEMENTATION 20
PLB Loading 20
Print Operation 21
Timing 22
Communications 23
Communication Sequence 23
Printer Module Port Connector J1 24
SUMMARY 24
SERVICE INFORMATION 24
Adjustments 24
Timing Belt 24
Slip Feed 24
Receipt Feed 25
Receipt Electro 25
Receipt Knife 26
Auto Receipt Feed Switch (S1) 26
Journal Feed 26
Journal Sensor Switch (S3) 27
Metering Rolls 27
Ink Pad 28
Ink Roll 28
Typewheel Line 29
Slip Sensor Switch (S3) Adjustment 29
Reluctance Heads 29
Print Hammer Adjustment 30
Mechanical Adjustment 30
Electrical Adjustment 30
Slip Table Adjustment 31
Carriage Drive Adjustment 31
Margin Adjustment 31
Preventive Maintenance 31
Lubrication Information 32
Lubricants Required 32
Lubrication Points 32
Teardown Procedures 34
Procedure for Replacing the Slip Hammers 34
Procedure for Replacing the Cam Line 35
Procedure for Replacing a Worn or Broken Timing Belt 36
Troubleshooting 36

ST 9152-18

M43-1-280 HELICAL PRINTER

INTRODUCTION

The Helical Printer module, M-43-1-280, provides the printed records of all transactions performed by the C-280 Retail Terminal. The general appearance of the helical printer and its location within the C-280 is shown in figure 1.

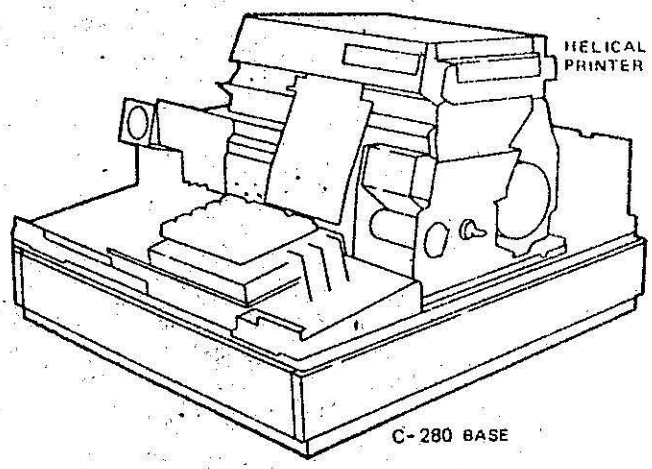


Figure 1 The helical printer, M43-1-280

The printer contains three 30-column print stations which are used to provide printed records on a sales slip, customer receipt, and transaction journal.

The slip print station is located on the left side of the printer. A slip may have a maximum of four sheets and is inserted face up with the top edge being inserted first. The print appears on the slip in descending order with the total being printed below the merchandise items. The slip print station contains a slip sensing mechanism that detects the presence of an inserted slip. The slip print station also provides an operator adjustable slip stop which aids the alignment of the slip for the initial print line. The slip is released at the end of a transaction (not ejected) and may be withdrawn from the slip print station by the operator.

The receipt print station is located on the upper right side of the printer. The receipt is a single part tape, size 280Z. An electro message is printed at the top of the receipt by a hard rubber stamp. The stamp is inked by a disposable, customer changeable, ink-impregnated pad. The print lines appear in descending order with the total being printed at the bottom. When closing out a transaction, the receipt is ejected and then cut off. A low receipt tape supply is indicated by color strips on the receipt starting about 5 feet from the end. Threading of a new roll of receipt paper is done automatically.

The journal print station is located on the lower right side of the printer. The journal is a single part tape, size 280D.

The print lines appear in ascending order with the last printed line appearing above all preceding print lines. The last printed lines are brought into view by advancing the tape manually with the journal key. The tape is retracted to its home position automatically upon releasing the journal key. The C-280 checks for a journal low condition during each transaction. If the journal paper supply is low, the JOURNAL LOW descripter is illuminated on the operator display. A journal low condition prevents another transaction from being initiated until a new journal tape is installed. The journal tape supply and take-up rolls are housed in a cassette type cartridge. This cassette has a locked door providing control over its removal or access to its contents. A new journal tape may be installed in the cassette whether the cassette is in or out of the printer.

The print mechanism operates using a helical or spiral typewheel movement. The typewheels are moved laterally while spinning at a constant velocity. Each typewheel has 40 characters embossed on its outer surface. The 40 characters are made up of 26 alpha, 8 numeric, and 6 special symbols. The alpha characters I and O are also used for the numeric characters one and zero respectively. The 40 character typewheel, therefore, provides 42 printed characters.

The print is accomplished by activating hammer mechanisms that follow the lateral typewheel movement. A hammer mechanism, when activated, applies a striking force toward the typewheel, carrying the paper media into contact with one of the characters embossed on the outer surface of the spinning typewheel. Inking of the typewheels is accomplished through the use of customer changeable, disposable, ink-impregnated rolls. Two ink rolls are used in the helical printer, one for the receipt and journal print station and the other for the slip print station.

The printer contains an electronic section which is made up of MOS/LSI circuitry and driver circuitry. This section directs the operation of the printing and forms handling devices of the printer.

The printer is a port module controlled by and deriving information to be printed from the TCU.

PHYSICAL DESCRIPTION

The helical printer is made up of a mechanical section and an electronics section. The printer is located centrally within the C-280 and mounted to the C-280 base above the cash drawer. The physical dimensions of the printer are the following.

Height	9 3/4 inches; 24.8 cm.
Width	12 1/4 inches; 32.2 cm.
Depth	9 1/2 inches; 24.2 cm.

ST 9152 18

MECHANICAL SECTION

The mechanical section of the printer, as shown in figure 2, contains the mechanical and electromechanical components of the printer. These components make up the slip, receipt, and journal print stations; the motor and drive mechanism; the solenoids controlling paper feed, electro print, and main clutch operation; and mechanical timing devices.

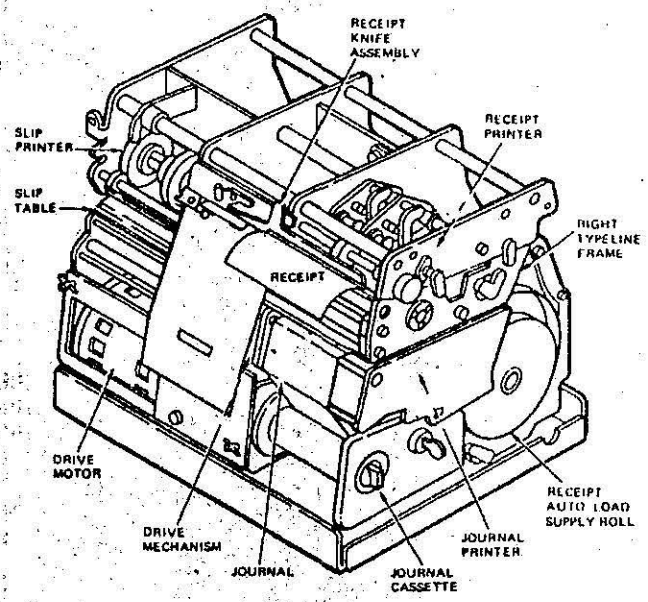


Figure 2 Printer mechanical section

ELECTRONICS SECTION

The electronics section of the printer is made up of two printed circuit boards, a logic board and a driver board which are located at the rear of the printer (refer to figs. 3 and 3a).

The logic board is approximately 10 inches by 6 inches in size and is located to the rear of the driver board. The logic board interfaces the TCU common port through connector J1. The logic board is connected to the driver board through connector J2. The logic board contains eight MOS/LSI arrays which incorporate the logic functions of the printer.

The driver board is approximately 8 inches by 8 inches in size and is located to the front of the logic board. The driver board is connected to the logic board through connector J2. Connector J3 interfaces the driver board with the electromechanical devices (solenoids and reluctance heads) of the printer. Connector J4 is the printer motor control interface. The driver board contains six hammer solenoid drivers, a reluctance head amplifier, two driver circuits for paper handling solenoids, switch sensing circuits, and motor control circuitry.

GENERAL DESCRIPTION

The helical printer is operated as a module on the common port of the TCU. The printer logic recognizes eight function codes from the TCU. These function codes are clear printer, accept format character, accept column address character, accept data character, motor ON, motor OFF, initiate, and is journal low. The function codes direct the operation of the printer logic. The printer informs the TCU of its present condition by sending one of four status codes to the TCU. These status codes are ready with slip, ready without slip, busy, and journal low.

The bit configurations of each function code transferred from the TCU to the helical printer and each status code transferred from the helical printer to the TCU are listed in table 1.

FUNCTION	CODE			
	b_8	b_7	b_6	b_5
Clear Printer (FCCLU)	1	0	0	1
Accept Format Character (FCFOR)	1	0	0	0
Accept Column Address Character (FCADS)	0	1	0	0
Accept Data Character (FCDTA)	0	0	1	0
Motor ON (FCMON)	0	0	1	1
Motor OFF (FCMOF)	1	0	1	1
Initiate (FCPRT)	0	0	0	1
Is Journal Low (FCJL)	1	0	1	0

STATUS	CODE			
	b_8	b_7	b_6	b_5
Ready With Slip (RWS)	0	1	0	0
Ready Without Slip (RWOS)	1	0	0	0
Busy (BUSY)	0	0	1	0
Journal Low (JL)	0	0	0	1

Table 1 Function and status codes

FUNCTION CODE IMPLEMENTATION

The operations performed by the printer on receipt of the function codes from the TCU are described in the following.

CLEAR PRINTER (FCCLU)

The clear printer function code causes the printer print line buffer to be reset to all zeros.

ACCEPT FORMAT CHARACTER (FCFOR)

This function code tells the printer logic that the next character received is the format character and to act upon it accordingly.

The format character is an 8-bit character that is sent to the printer at any time prior to the beginning of a print cycle; therefore, buffering is provided for this character. The format character controls printing, finalizing procedure,

M43-1-280 HELICAL PRINTER

M-43 LOGIC BOARD

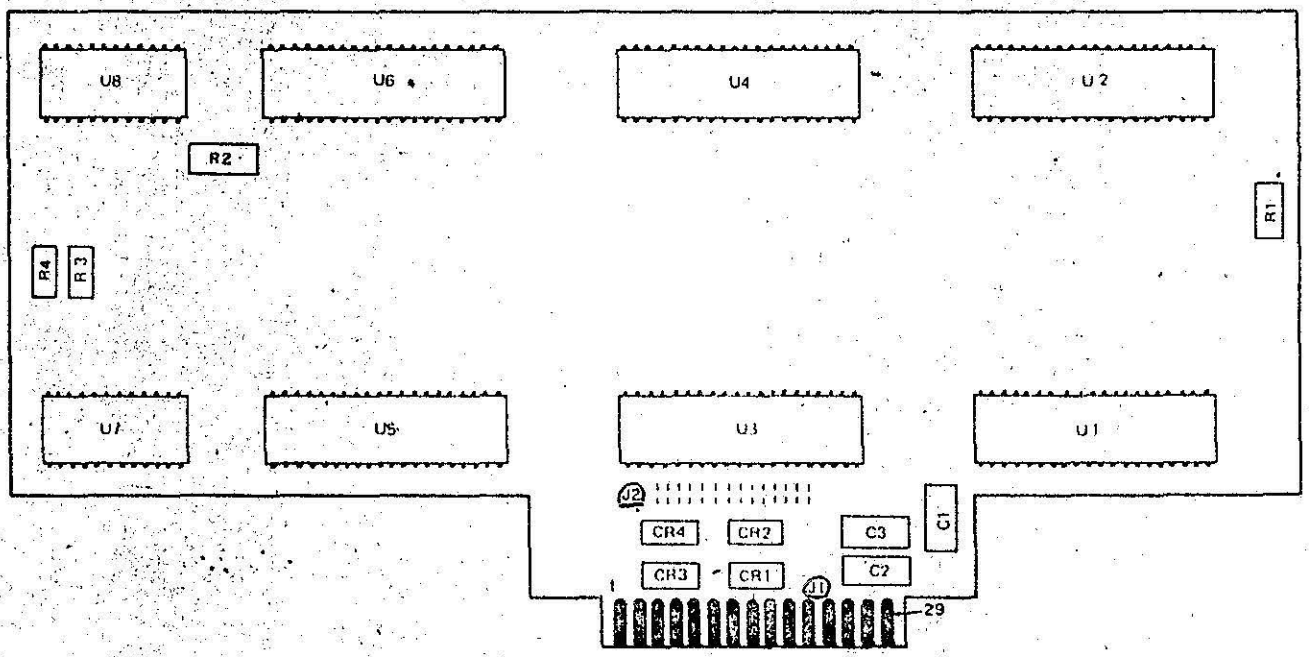
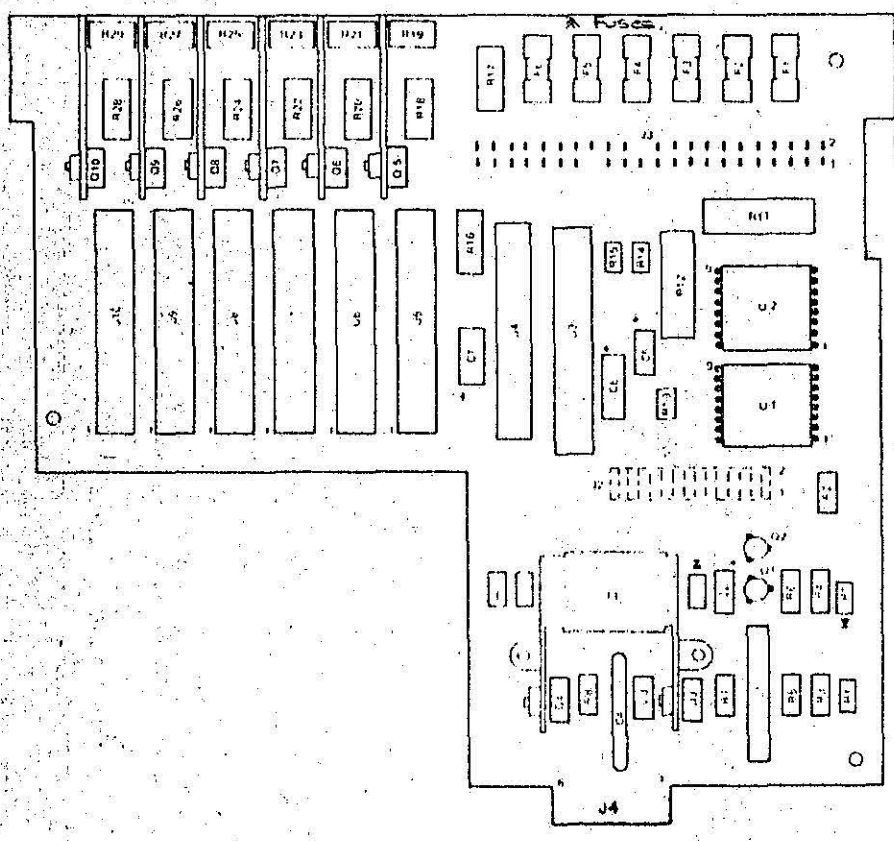


Figure 3 Logic board

W/O change 29



PCBR Change
*Fuses are sometimes removed as they are useless.
(Upgraded Board Overleaf)

Figure 3a Driver board component locations (1 of 3)

With change 29

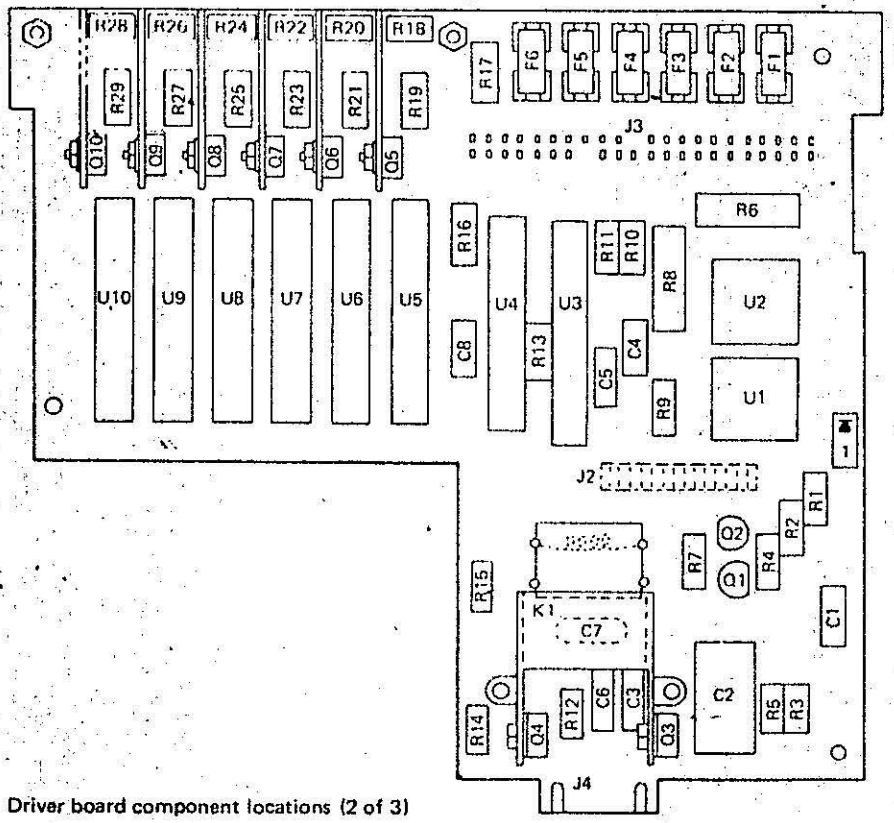


Figure 3a Driver board component locations (2 of 3)

FUSELESS

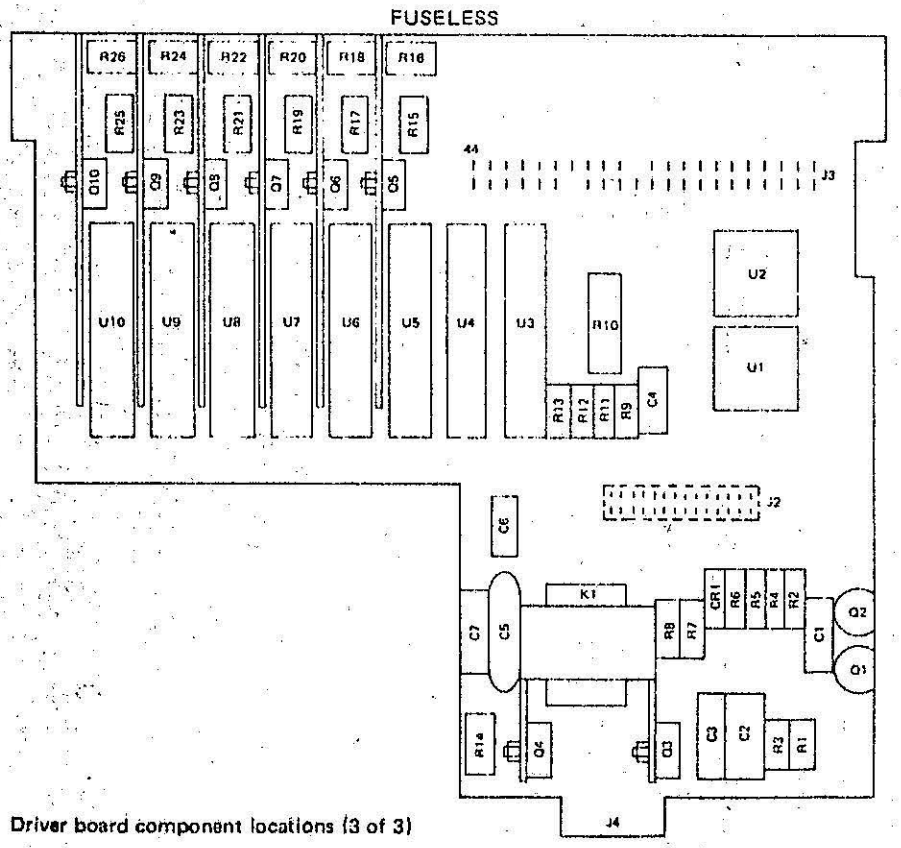


Figure 3a Driver board component locations (3 of 3)

M43 1280 HELICAL PRINTER

and line feed according to the following format.

Format Character Format

b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1
J	R	S	End Trans	Line Feed			

Bit 8 = 1: print on journal
Bit 7 = 1: print on receipt
Bit 6 = 1: print on slip
Bit 6, 7, and 8 = 0: line feed for slip only

Bit 5 = 1: If printing on the slip, release the compression rolls after print. If printing on the receipt, print the electro message, feed 10 lines, and cut off the receipt.

Bits 1 to 4: These bits indicate the number of lines to be fed. If printing on the slip, bits 1 to 4 are used (0 to 15 lines maximum). If printing on the receipt, only bits 1 and 2 are used (0 to 2 lines maximum).

ACCEPT COLUMN ADDRESS CHARACTER (FCADS)

This function code tells the printer logic that the next character received is a column address character.

The column address character specifies the column in which the next data field is to start. This is an 8-bit character with the five least significant bits specifying the column number. This number ranges from 0 to 29 (corresponds to columns 1 through 30). Bits 6, 7, and 8 of the column address character are ignored.

ACCEPT DATA CHARACTER (FCDTA)

This function code tells the printer logic that the next character received is a data character.

The data character contains the data to be printed. It is an 8-bit character as received from the TCU and converted to a 6-bit data character by the printer logic for internal use.

MOTOR ON (FCMON)

This function code tells the printer logic to turn ON the drive motor which causes the typewheels to spin in home position. FCMON must be received from the TCU with enough lead time to permit the typewheels to accelerate to operating speed (1500 RPM). Usually FCMON precedes FCPRT by 1 second; however, the exact time is determined by the TCU firmware.

MOTOR OFF (FCMOF)

The function code tells the printer logic to turn OFF the drive motor. FCMOF is received after the print cycle has been completed and the typewheels have been traversed to their home position on the last print cycle of an operation. The time elapsed between the end of the last print cycle and the receipt of FCMOF is determined by the TCU firmware.

IS JOURNAL LOW (FCJL)

This function code tells the printer logic to check for a journal low condition. If, upon receipt of FCJL, the journal tape supply is found to be low, the printer sends the journal low status code to the TCU. If the journal tape supply is not low when checked, the printer sends the RWS or RWOS status to the TCU.

INITIATE (FCPRT)

This function code tells the printer logic to print the data contained in the PLB (print line buffer) according to the format outlined by the format character. FCPRT is received by the printer after all the data desired for a particular print line has been received. FCPRT initiates the print cycle.

STATUS CODE IMPLEMENTATION

The helical printer keeps the TCU aware of its current availability by sending status codes to the TCU.

READY WITH SLIP (RWS)

This status code tells the TCU that the printer is ready to accept information and a slip is inserted in the slip print station.

READY WITHOUT SLIP (RWOS)

This status code tells the TCU that the printer is ready to accept information and a slip is not inserted in the slip print station.

BUSY (BUSY)

This status code tells the TCU that the printer is presently carrying out a function and cannot accept information.

JOURNAL LOW (JL)

This status code tells the TCU that the printer journal tape supply is low. JL is sent to the TCU only after the TCU sends FCJL asking for the status of the journal tape supply, and the journal tape supply is found to be low. If, when checked, the journal tape supply is not low, the printer sends either RWS or RWOS to the TCU. If the journal tape supply is found to be low when checked, the JOURNAL LOW descriptor is illuminated on the operator display and a new transaction may not be initiated until an adequate journal tape supply is present.

MECHANICAL DESCRIPTION

The mechanical section of the printer includes the mechanical and electromechanical devices used to perform printing and paper handling. These devices make up nine functional areas which effect the operation of the mechanical section of the printer. These nine areas perform printer drive, printing, typewheel inking, journal feed, slip feed, auto receipt paper threading, receipt feed, electronic inking and printing, and receipt knife operation.

PRINTER DRIVE

The printer drive mechanism activates typewheel rotation and lateral traversing. The drive mechanism also controls cam line operation (refer to figure 4).

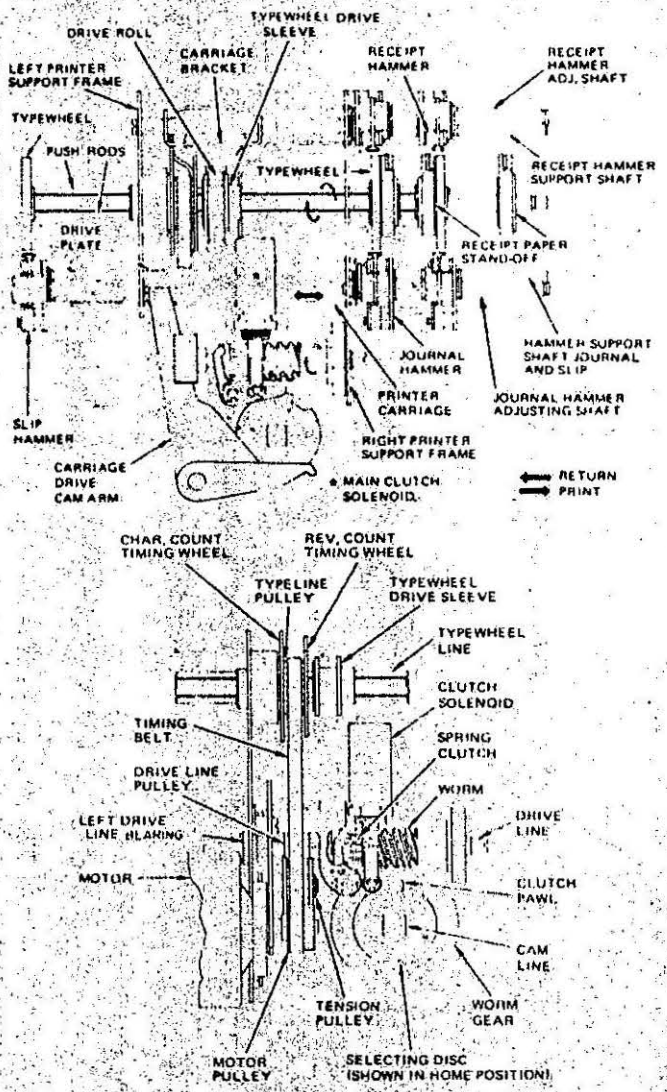


Figure 4 Printer drive mechanism

The printer motor powers the printer drive mechanism. The motor is activated by the application of 115 v.a.c. ±10 percent at 50 ± 1 or 60 ±1 Hz which is derived from the a.c. input terminal block of the M32-1-280 power supply, and routed to the printer motor through the printer electronics section. The motor shaft pulley drives a cogged timing belt. The timing belt is connected to a pulley on the drive line and a pulley on the typewheel line. When the motor is operating, the typewheel line and the drive line rotate at a speed of 1500 r.p.m. A worm is attached to the drive line through a spring clutch and is held disengaged from the drive line by the clutch pawl. The clutch pawl is held in a low of the selecting disc when the printer is idling in home position. The worm is meshed with a worm gear on the cam line. The printer logic, having received an initiate function code (FCPRT) from the TCU, activates the main clutch driver circuit which generates a pulse to energize the main clutch solenoid. The main clutch solenoid, being energized, raises the clutch pawl and releases the spring clutch which bonds the worm to the drive line. This action permits the worm gear to turn the cam line clockwise. The selecting disc prevents the clutch pawl from disengaging the spring clutch for a full rotation of the cam line.

The lead carriage cam attached to the cam line rotates clockwise, pivoting the carriage drive cam arm top to the right and moving the printer carriage laterally to the right. The hammer mechanisms are mounted on sleeves attached to the printer carriage and follow its lateral movement to the right. The drive sleeve and the typewheels on the typewheel line are clipped to two push rods (one on either side of the square typewheel line). The drive roll on the carriage bracket engages the drive sleeve on the typewheel line. The typewheels follow the lateral movement of the printer carriage and the hammers remain correctly positioned in relation to the typewheels. Two typewheels are used to print 30 columns (15 columns/typewheel). Printing occurs during the right lateral movement of the printer carriage. The follow carriage cam returns the printer carriage to the home position (maximum left) at the end of one cam line revolution, and the clutch pawl drops into the low of the selection disc disengaging the spring clutch from the drive line. This completes one print cycle; however, the typewheels continue to rotate until a motor off (FCMOF) function code is received by the printer logic.

PRINTING

Each typewheel has 40 characters embossed on its outer surface in a helical (spiral) pattern. This helical pattern permits the characters to remain in a central position relative to each column as the typewheels are rotating and traversing laterally (refer to figure 5).

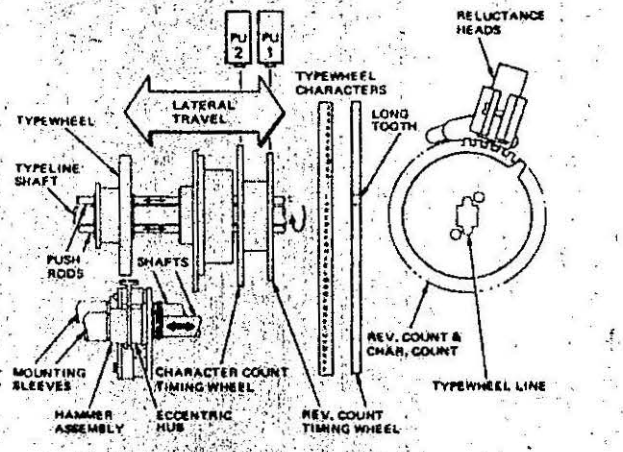


Figure 5 Printing mechanism

Two timing wheels are attached to the typewheel line but do not traverse. These timing wheels have projections that indicate to the printer logic, through magnetic reluctance heads, the position of the typewheel line during rotation. The revolution count timing wheel has one projection on its perimeter. When the projection on the revolution count timing wheel is directly opposite the revolution count

reluctance head, a signal is sent to the printer logic indicating that the typeline is in home position rotation wise. A character count timing wheel is also attached to the typewheel line and contains 40 projections with each projection corresponding to a particular character on the typewheels. A hammer solenoid is energized as the character to be printed approaches the print line. Contact is made by the hammer against the paper and the paper is driven into contact with the desired typewheel character.

TYPEWHEEL INKING

Ink is transferred from the disposable ink roll to the metering roll and to the typewheel characters at the end of each print cycle. Figure 6 depicts receipt and journal typewheel inking. The inking of the slip typewheels is similar to that shown except that only one metering roll is required and drive is supplied from a drive line connected to the receipt ink roll linkage.

The cam arm riding on the ink roll cam pivots the ink roll lever which raises the ink roll arm. The spring loaded ink roll is pulled into contact with the metering roll. The metering roll is being turned by the typewheels. Further rotation of the cam line restores the ink roll away from the metering roll.

Printing on the journal removes ink from a typewheel character but contact with the second metering roll inks the character prior to printing on the receipt.

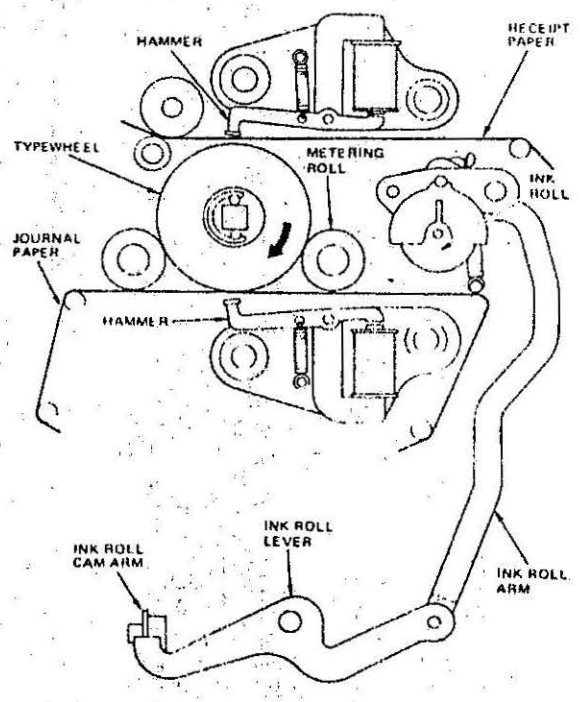


Figure 6 Typewheel inking mechanism

JOURNAL FEED

The journal cassette contains the supply spool, receiving spool, and the paper guides for the journal.

When a print cycle is initiated, the cam line turns, engaging a cam arm that moves the receipt feed link upwards (refer to fig. 7). A stud on the link moves upward releasing the journal feed lever. The journal feed lever is permitted to follow the stud if the journal feed solenoid is energized. If the journal feed solenoid is not energized, the journal feed lever stops against the stop pawl. The journal feed solenoid is energized when a journal feed signal is received from the printer electronics. With the journal feed solenoid energized, the stop pawl is out of the path of the journal feed lever which moves top to the front followed by the journal feed arm until the journal feed arm contacts the camming surface of the equalizer yoke. When the receipt feed link is pulled down at the end of the print cycle, the journal feed lever and arm are rotated top to the back. The roller clutch causes the receiving spool to turn, feeding one line of paper. This action is repeated each print cycle that the journal feed solenoid is energized.

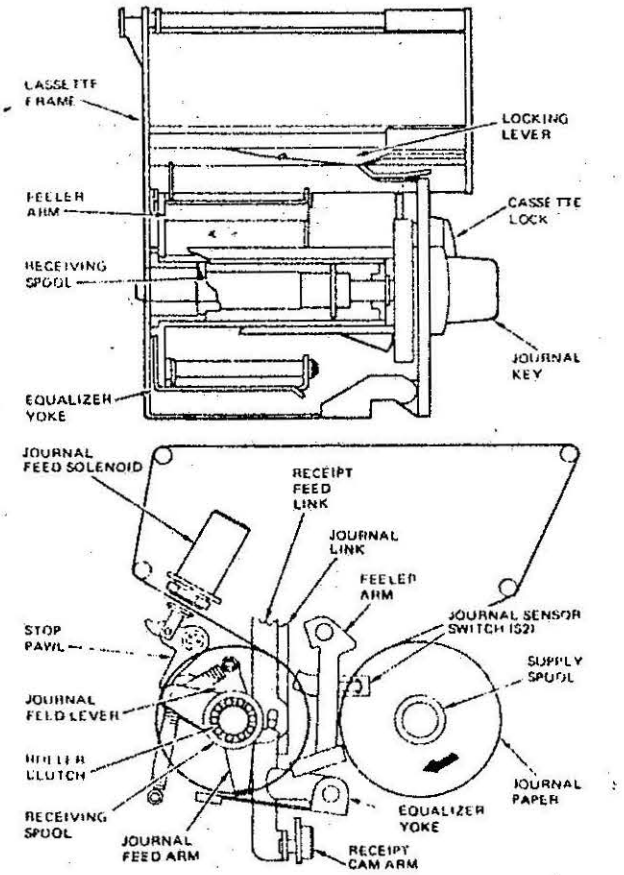


Figure 7 Journal feed mechanism

The amount of rotation of the receiving spool is determined by the position of the equalizer yoke. The equalizer yoke limits the travel of the journal feed arm and follows the circumference of the paper on the receiving spool. This varies the angular movement to maintain an equal distance between print lines.

The journal feeler arm follows the circumference of the paper on the supply spool. When the paper supply is almost exhausted, the feeler arm activates the journal low switch.

SLIP FEED

The slip feed mechanism is depicted in figure 8. When a slip is inserted, the slip sensor switch is activated, signaling slip presence to the electronic section. The electronic section sends a signal to the pressure roll solenoid, energizing it. The pressure roll solenoid, being energized, causes the pressure roll to be moved downward into contact with the feed roll.

A drive gear is attached to the left end of the drive line which rotates when power is applied to the drive motor. The drive gear meshes with the clutch gear which is connected to the slip feed cam through a spring clutch. The slip feed solenoid is activated on receipt of a signal from the printer electronics. The solenoid, when activated, pulls down the clutch pawl allowing the spring clutch to engage the slip feed cam. The slip feed cam contacts a stud on the spring loaded pitman, which moves the pitman upward. The pitman engages the feed arm which is connected to the feed roll gear through a spring clutch. The spring clutch is engaged when the pitman is moving upward and rotating the feed roll line. As the pitman drops off the high surface of the slip feed cam, it moves downward, disengaging the spring clutch. The feed adjusting screw limits the cocking movement given during the downward movement of the pitman. The feed adjusting screw adjusts the length of feed to six lines per inch. When more than one line of slip feed is desired, the solenoid is held energized, causing the slip feed cycle to be repeated.

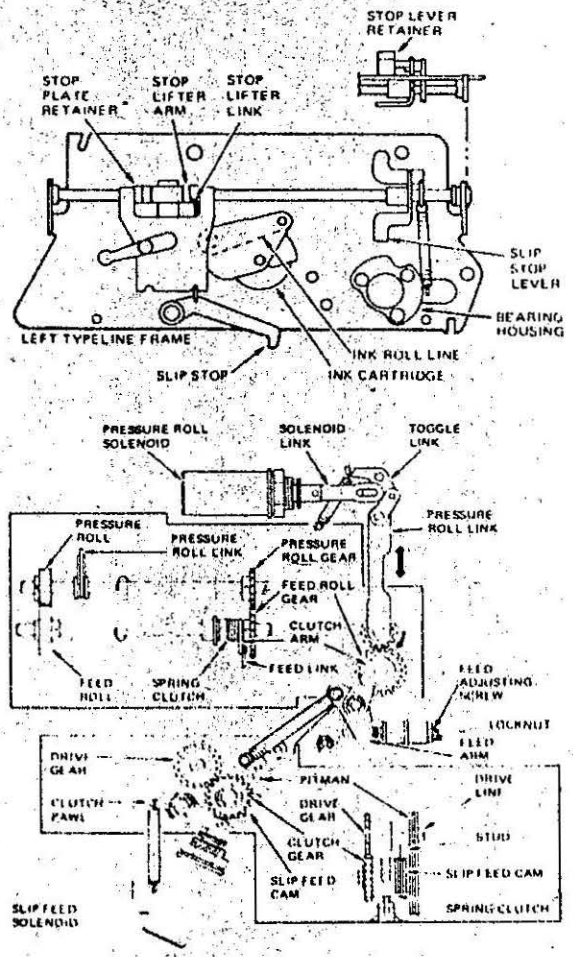


Figure 8 Slip feed mechanism

An operator adjustable slip stop is located to the rear of the slip table which is adjustable to limit the amount of initial slip insertion for proper first line print. This slip stop is raised clear of the slip when the pressure roll solenoid is energized.

NOTE: The slip stop may be reversed from the position shown in figure 8 to permit insertion of forms with a longer distance between the top and the first print line.

AUTO RECEIPT PAPER THREADING

The automatic receipt paper threading mechanism is depicted in figure 9. A receipt paper roll is placed in the loading area with the loose end of the roll pointing in a counterclockwise direction. The threading operation is accomplished by pressing the receipt feed lever.

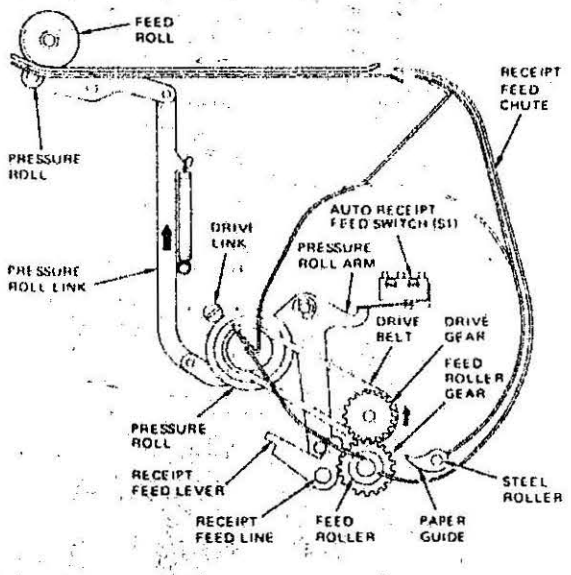


Figure 9 Auto receipt threading mechanism

When the receipt feed lever is pressed, an arm on the receipt feed line contacts a stud on the pressure roll arm. The pressure roll arm pivots, releasing the actuating arm of the microswitch and causes power to be applied to the drive motor. The drive motor turns the drive line. The pressure roll arm movement also presses the pressure roll against the knurled surface of the drive line. The pressure roll rotates, turning the drive gear through the drive belt. The drive gear is meshed with the feed roller gear which rotates the feed roller through engagement of a roller clutch. The paper is resting on the feed roller. The rotation of the feed roller causes the paper roll to rotate counterclockwise. The leading edge of the paper roll is separated from the remainder of the roll by the paper guide which guides the paper into the receipt feed chute.

M43-1-280 HELICAL PRINTER

The pressure roll arm is also connected to a pressure roll link which is moved upward as the receipt feed lever is pressed causing the receipt pressure roll to move away from the receipt feed roll. This permits the receipt paper to pass through the receipt feed roll area.

When the receipt feed lever is released, the drive motor turns OFF, the receipt pressure roll moves up, and the drive roll moves away from the drive line.

RECEIPT FEED

The receipt feed mechanism spaces paper for a one line feed, two line feed, and ten line long feed (refer to figure 10).

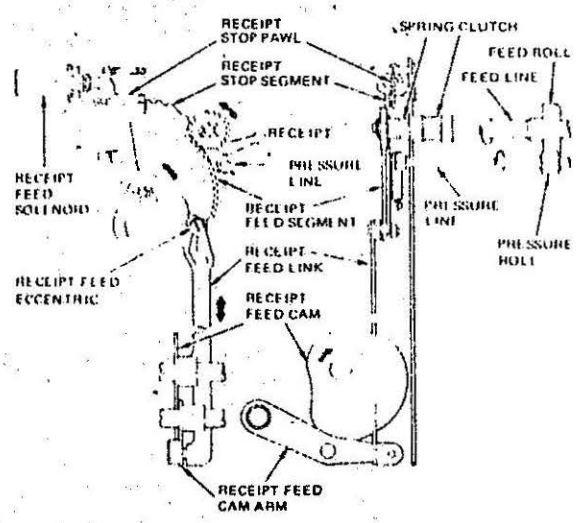


Figure 10 Receipt feed mechanism

When a print cycle is initiated, the receipt feed cam turns, engaging a roll on the receipt feed cam arm, permitting the receipt feed link to move upwards as the cam line turns. The receipt feed link, moving upward, permits the receipt feed segment and stop segment to move to the rear under spring tension. The receipt feed segment drives the receipt feed gear which is attached to the feed line through a spring clutch. When the receipt feed link is moving upward, the spring clutch is disengaged, preventing movement of the feed line. The stop segment has two notches cut out of its upper portion.

A one line feed occurs when the receipt feed solenoid is held energized until the first notch of the stop segment is directly below the lip of the stop pawl. The solenoid is de-energized causing the stop pawl to drop into the first notch of the stop segment and prevent further backward movement of the stop segment. Near the end of the operation, the receipt feed link is moved downward by the cam arm. The receipt feed link, moving down, pulls the receipt feed segment and stop segment to the front. The stop pawl is cammed out of the notch of the stop segment. The receipt feed segment, moving to the front, causes the spring clutch to engage and turn the feed line. The feed line, turning, advances the receipt paper one line.

A two line feed requires that the solenoid be held energized until the second notch of the stop segment is directly below the stop pawl. Two lines are fed when the segments move to the front.

A ten line feed requires that the solenoid be held energized until both notches of the stop segment have passed under the stop pawl. The receipt feed segment and stop segment continue to rotate to the rear, limited only by the receipt feed link movement. Ten lines are fed during the forward movement of the segments.

A knurled knob is connected to the feed line to allow manual receipt paper feed. When the knurled knob is turned top to the back, a spring clutch is disengaged, preventing movement of the receipt feed gear as paper is advanced.

ELECTRO INKING AND PRINTING

The electro inking and printing mechanism operates only after a long receipt feed signal is received, ensuring that the electro print is clear of all printed lines and positioned at the top of the customer receipt (refer to fig. 11).

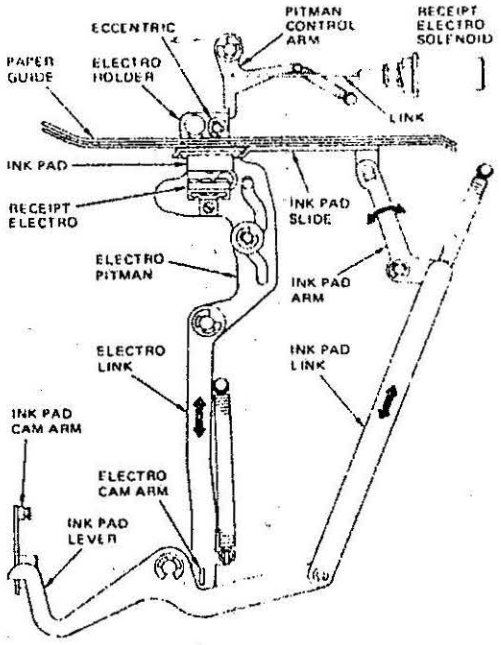


Figure 11 Electro printing and inking mechanism

During each print cycle, including those in which no electro print is desired, the ink pad cam arm is driven upward by the ink pad cam which pivots the ink pad lever. The pivoting ink pad lever causes the ink pad link to move down which moves the ink pad slide and ink pad to the rear. At the end of a print cycle, the ink pad slide and ink pad are moved forward to the home position.

The electro cam arm follows the contour of the receipt electro cam and is connected to the spring-loaded electro link. When the first low of the receipt electro cam is

encountered, the electro link moves upward, moving the electro pitman up until it is stopped by the control arm. When electro print is desired, the electro solenoid is energized moving the control arm out of the path of the rising electro pitman. The electro pitman moves upward, carrying the electro into contact with the ink pad which is still in home position. A high on the receipt electro cam causes the electro to move down away from the ink pad. The ink pad is moved to the rear as described in the previous paragraph. A second low of the receipt electro cam is encountered which permits the electro to move upward again until it contacts the receipt paper in the paper guide leaving an electro print. Near the end of the operation, a high on the receipt electro cam causes the electro to move downward to its home position. After the electro has moved down, the ink pad is moved forward to its home position.

RECEIPT KNIFE

The receipt knife mechanism cuts off the receipt after a long receipt feed (10 lines). The knife mechanism is shown in figure 12.

During a long receipt feed operation, the receipt feed segment rotates top to the back, cocking for the paper feed. A stud on the lower portion of the receipt feed segment moves to the front, moving the knife release arm which unlatches the knife operating link pawl. The spring loaded knife operating link pawl moves its lower portion directly above the knife cam arm. The knife cam arm follows the circumference of the knife cam. A low on the knife cam causes the knife cam arm to move upward. The upward movement of the cam arm raises the knife operating link and the knife operating arm. The knife operating arm moves upward, contacting the knife latch. The knife latch rotates counterclockwise unlatching the knife. The upper knife snaps clockwise, powered by a spring, cutting the receipt paper. The amount of knife travel is limited by the adjustable knife stop attached to the knife latch.

The knife is raised when the knife cam arm pulls the knife operating arm downward at the beginning of the next operation. When the knife is raised, the lip on the left end of the knife moves downward, permitting the knife latch to move over the top of and latch the knife in its home position.

If, during a print cycle, long feed is not initiated, the knife cam arm moves up and down in the slot of the knife operating link without imparting trip movement to the knife latch.

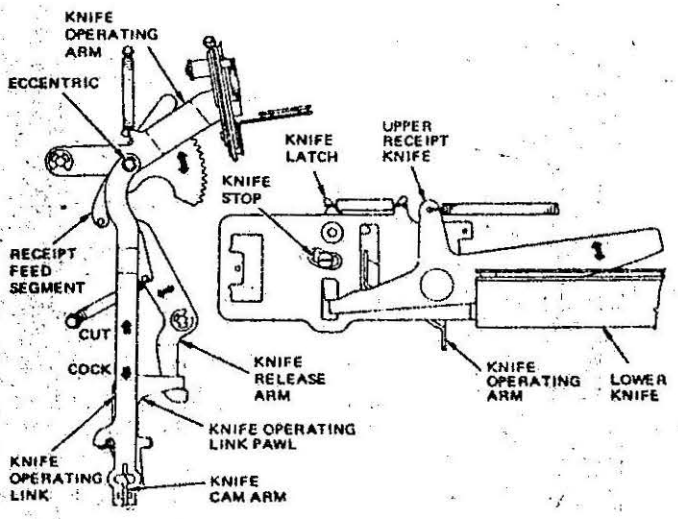
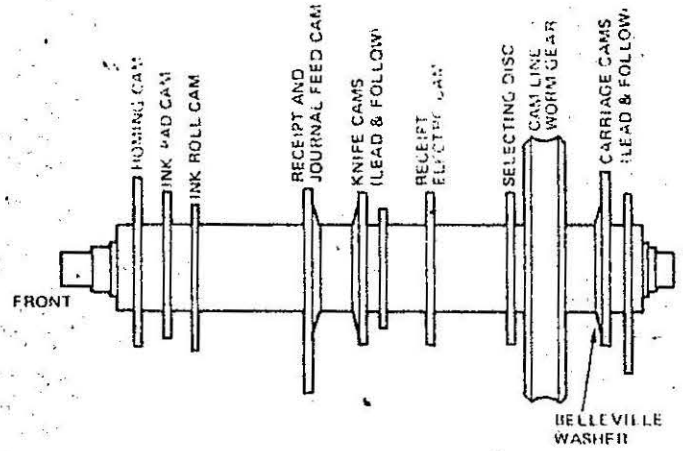


Figure 12 Receipt knife mechanism

CAM LINE TIMING

The cam line makes one revolution each print cycle and imparts movement to the mechanical devices of the printer through camming discs which are mounted on its square shaft. Two camming discs are sometimes used to perform a cam function. When two are used, one is referred to as the lead cam and the other a follow cam. The shape of the single or two disc cams and their rotational position with respect to each other determines the relative timing of the mechanical functions performed by the printer (refer to fig. 13).

Zero degrees of the cam line is indicated when the punch mark on the front end of the cam shaft is at its highest position.



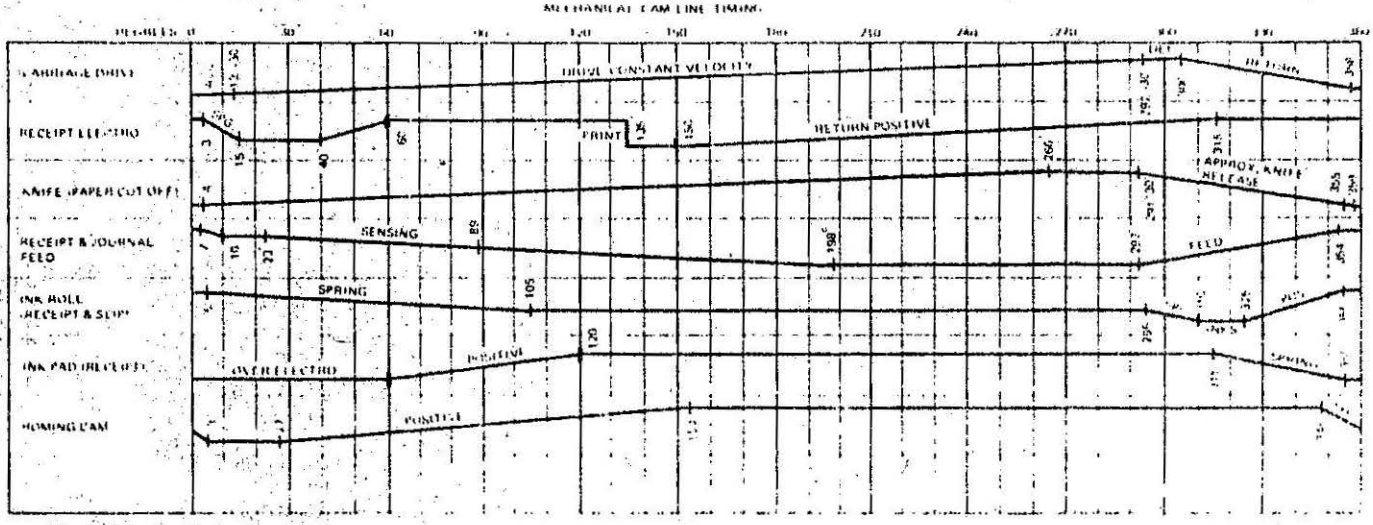


Figure 13 Cam Line

STATUS GENERATION LOGIC

The status generation logic creates the status characters which are sent to the TCU. The status characters sent are those described in the *General Description.* This logic segment receives inputs from the function recognition logic, mechanism control logic, slip sensor switch, and journal low switch. The input received from the function recognition logic asks the status of the journal low switch. The input from the journal low switch is used to generate a journal low status code (JL) if the journal is low when checked by the function recognition logic. The input from the mechanism control logic indicates whether or not the printer is busy performing an operation. If the printer is busy, the BUSY status code is sent to the TCU by the status generation logic. The input from the slip sensor switch indicates the presence or absence of a slip in the slip printer.

MOTOR CONTROL LOGIC

The motor control logic signals the driver board to either turn ON or turn OFF the printer motor. This segment receives its input from the function recognition logic when directed by FCMON or FCMOF.

LINE FEED CONTROL LOGIC

The line feed control logic receives its input from the function recognition logic, is synchronized by a pulse from the revolution count reluctance head, and directs the operation of the mechanism control logic.

MECHANISM CONTROL LOGIC

The mechanism control logic segment receives input from the line feed control logic and controls the receipt feed, journal feed, slip feed, main clutch, electro print, and compression roll solenoids. This segment also provides a busy status signal to the status generation logic during a print cycle and indicates main clutch solenoid status to the character generation logic.

PLB (PRINT LINE BUFFER)

The PLB consists of thirty 6-bit registers which are used to store one complete print line of data characters. The PLB is loaded from the PLB loading control logic with the data characters to be printed. When a print cycle is initiated, the contents of the PLB is shifted and each character in turn is examined by the compare logic for a true comparison. When the PLB is completely loaded, the first 6-bit register contains the data to be printed in column 30 and the last 6-bit register contains the data to be printed in column 1.

PLB POSITIONING CONTROL LOGIC

The PLB positioning control logic controls and monitors the loading and shifting of the PLB. The column address character received from the function recognition logic determines which position of the PLB is to be loaded.

PLB LOADING CONTROL LOGIC

The PLB loading control logic converts the 8-bit data characters to six bits each and performs the loading of the PLB as directed by the PLB positioning control logic.

COMPARE LOGIC

The compare logic compares each character in the PLB with the characters received from the character generation logic to determine hammer fire timing. Every character code output from the character generation logic is compared to the character contained in each column position of the PLB. If a true comparison exists, the examined PLB character is printed.

CHARACTER GENERATION LOGIC

The character generation logic generates 42 separate 6 bit codes corresponding to the characters on the typewheel. This segment consists of a 6-bit register which is advanced for each character on the typewheel by an input from the character count reluctance head. This indicates to the compare logic the position of each character as it approaches the printing position. The other inputs to this segment are from the revolution count reluctance head which indicates when to initiate the character count, and the mechanism control logic which indicates when the print cycle begins. The alpha O and numeric zero are the same character on the typewheel. When this character is approaching the printing position, it is decoded as an alpha O and an additional character is generated for the numeric zero. Both codes are sent to the compare logic. A similar process occurs with an alpha I and a numeric one. An alpha Z is sent to the compare logic when the typewheels are spinning in home position (print cycle not yet initiated).

RECEIPT HAMMER DELAY COUNTER A

Receipt hammer delay counter A provides a 20 msec. delay from the time a valid compare is received from the compare logic until the receipt hammer fire pulse is generated. This delay permits the compared character on the typewheel to travel 180 degrees from the journal to the receipt print area. The delay is required because the journal and receipt print stations share the same typewheels. Two type A counters are present, one for each receipt hammer.

RECEIPT HAMMER DELAY COUNTER B

Receipt hammer delay counter B, like counter A, provides a 20 msec. delay from the time a valid compare is received from the compare logic until the receipt hammer fire pulse is generated. The difference between counter A and counter B is evidenced in the application. Counter B is used only when counter A has not yet timed out and the next character to be printed has been compared by the compare logic. This occurs when the next character to be printed is less than 180 degrees from the character presently being delayed by counter A. When this occurs, counter B develops the delay time for the second character. Two B counters are present, one for each receipt hammer.

M43-1-280 HELICAL PRINTER

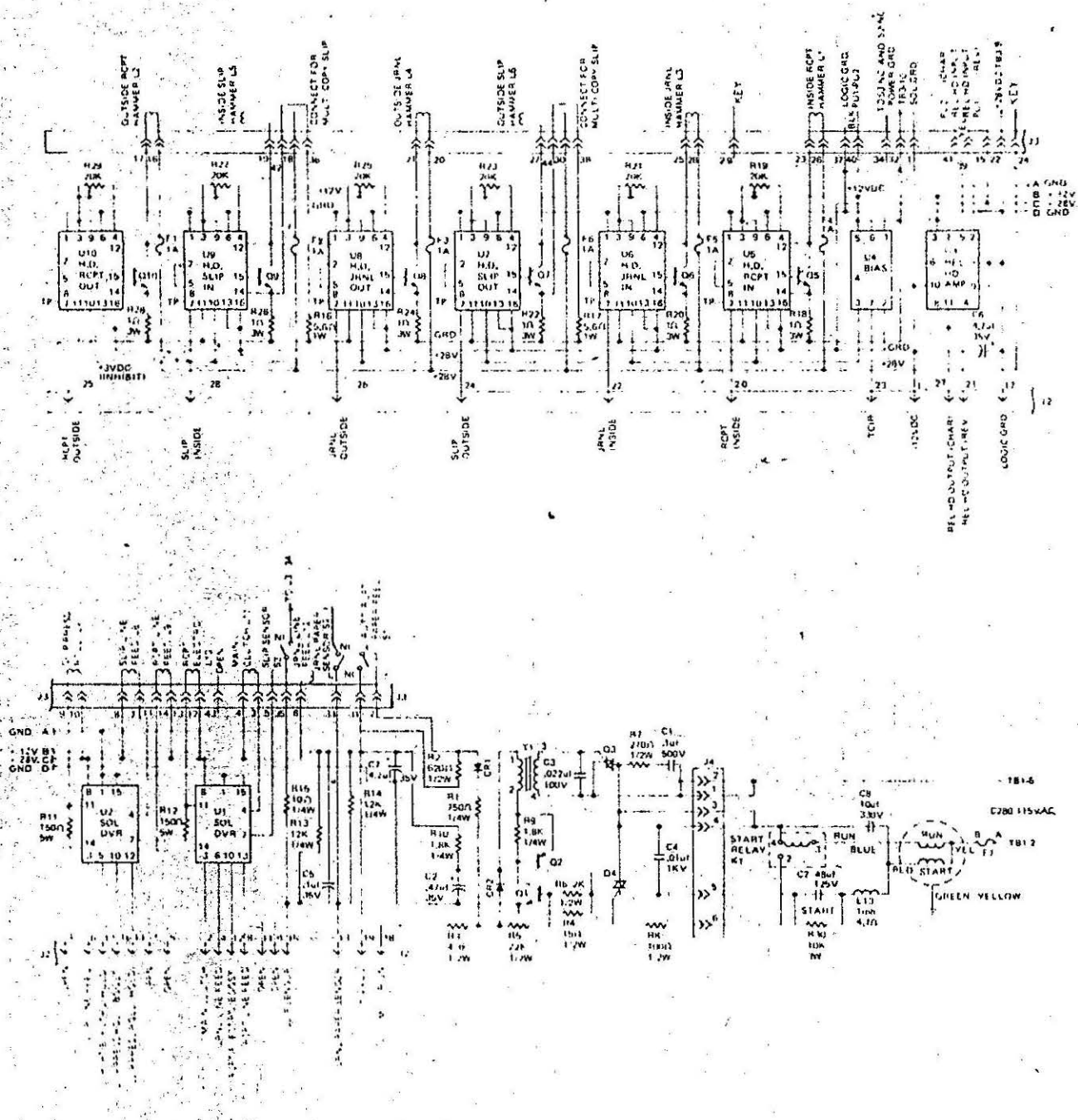


Figure 16 Driver circuitry schematic diagram (w/o change 29)

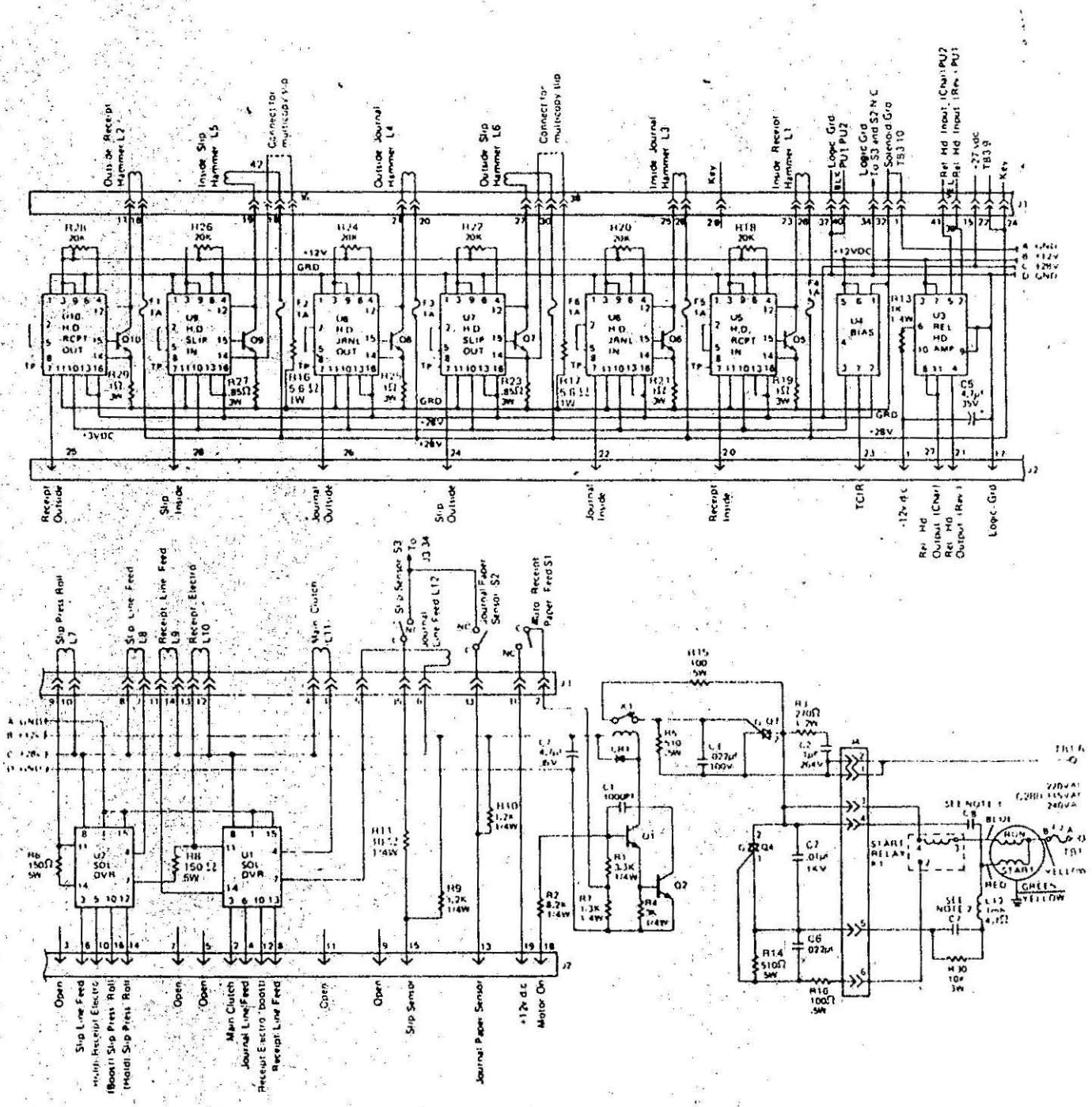


Figure 16.1 Driver circuitry schematic diagram (with change 29)

NOTE 1: For C8 with 115V motor values are 10µf 330V with 220 or 240V motor values are 3µf 370V.

2: For C7 with 115V motor values are 48µf 125V with 220V or 240V motor values are 14µf 270V.

M43-1-280 HELICAL PRINTER

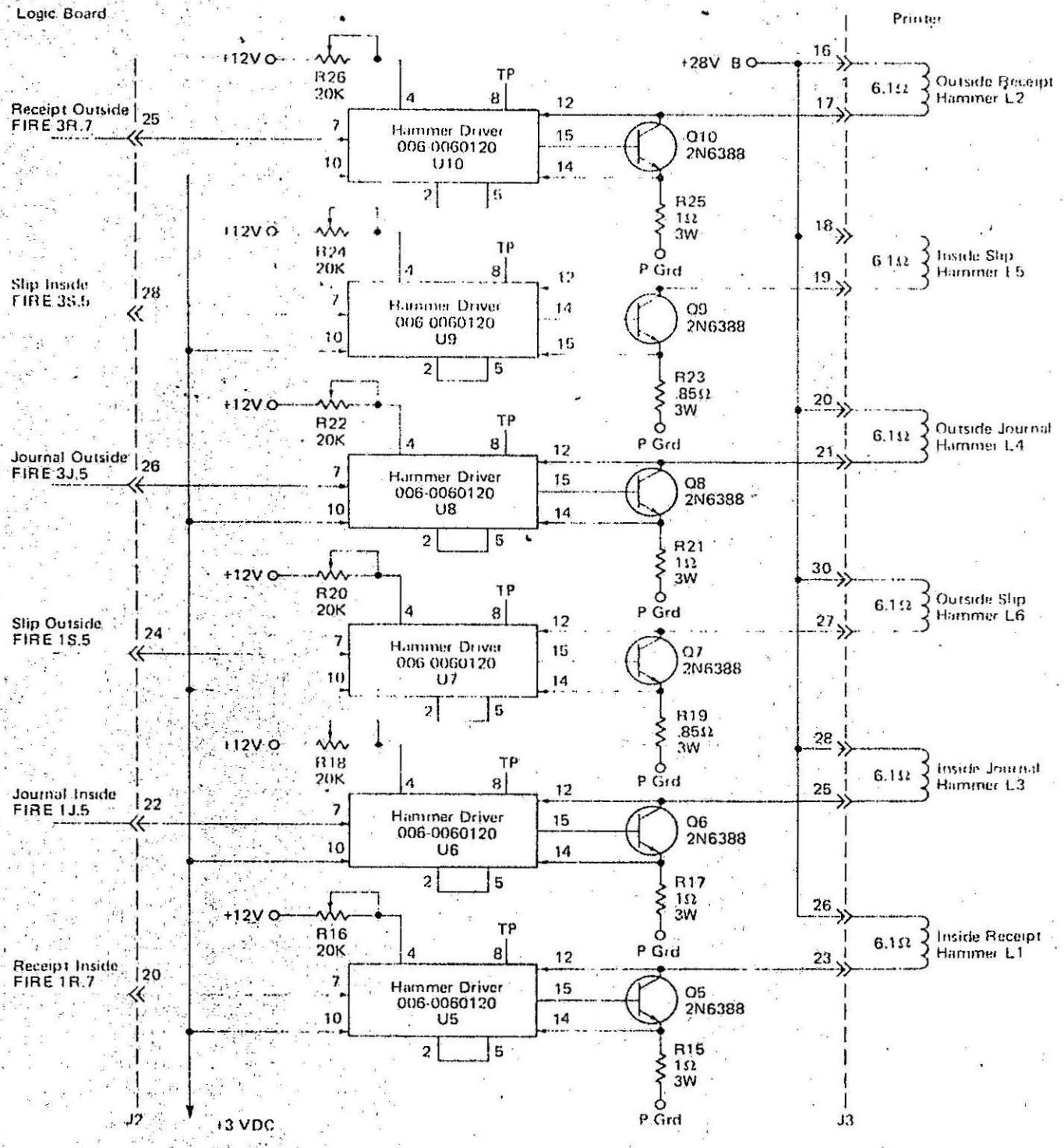


Figure 16b Driver circuitry schematic diagram (fuseless) (1 of 3)

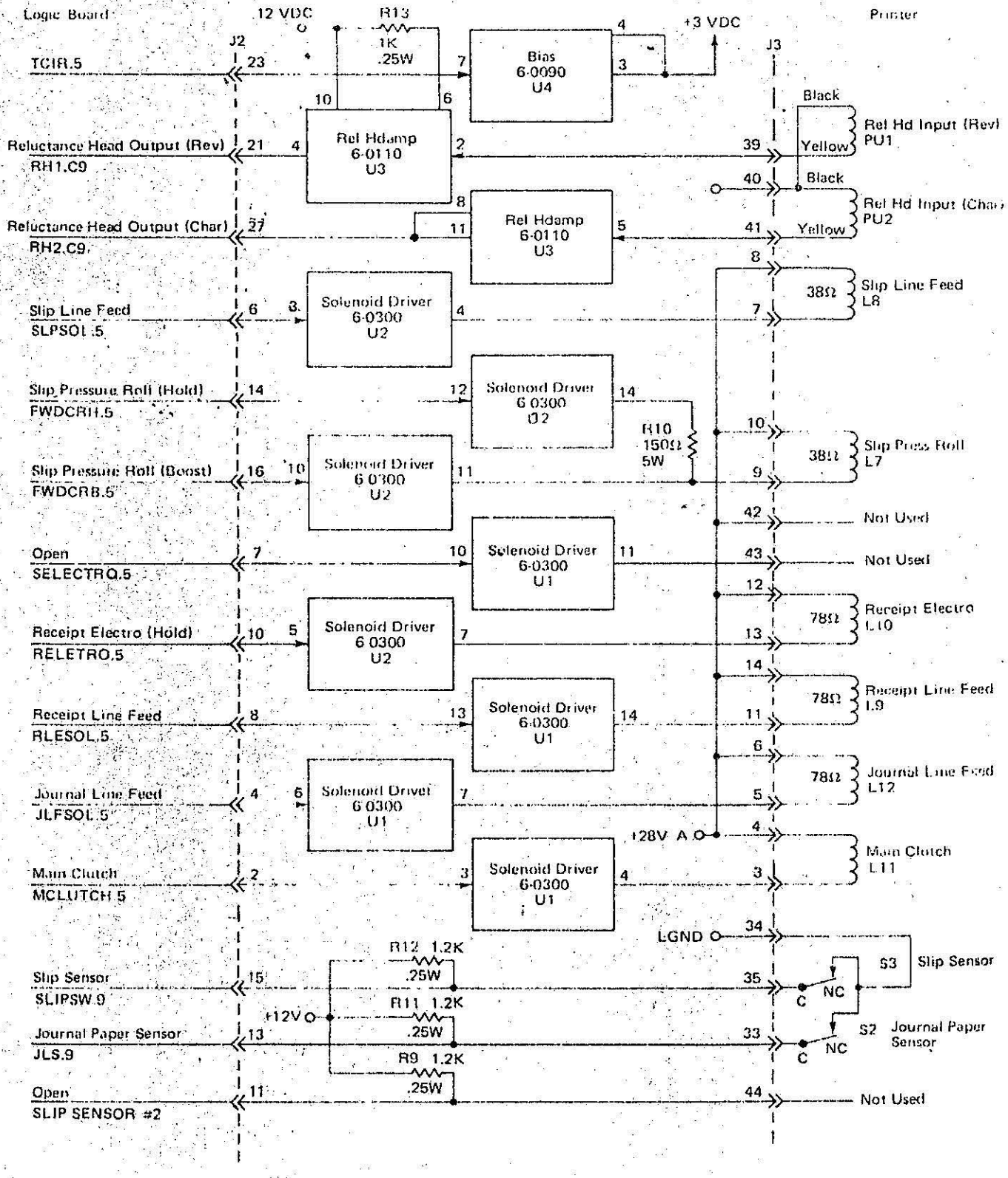
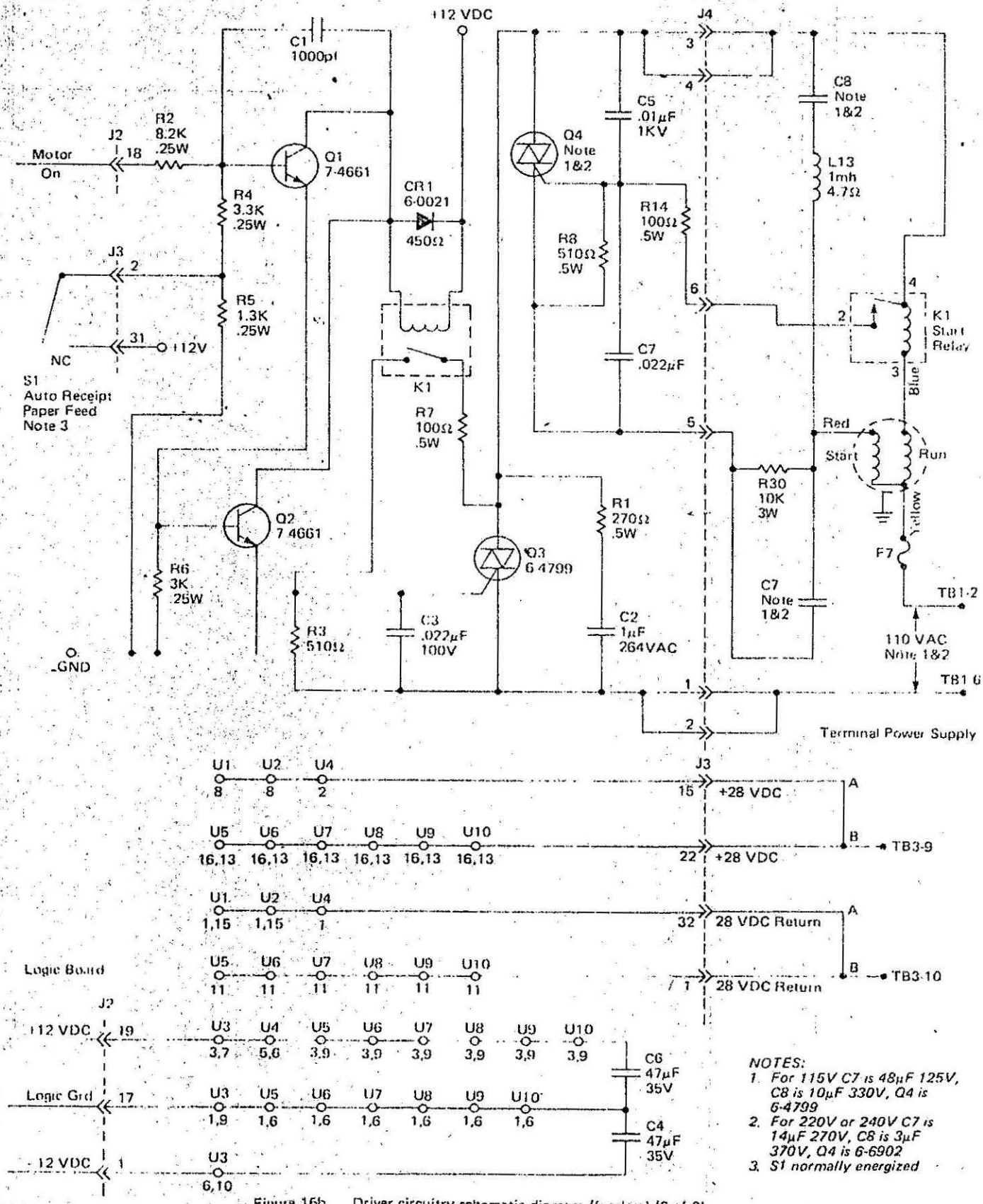


Figure 16b Driver circuitry schematic diagram (fuseless) (2 of 3)



NOTES:
1. *For 115V C7 is 48μF 125V, C8 is 10μF 330V, Q4 is 6-4799*
2. *For 220V or 240V C7 is 14μF 270V, C8 is 3μF 370V, Q4 is 6-6902*
3. *S1 normally energized*

Figure 16b Driver circuitry schematic diagram (fuseless) (3 of 3)

HAMMER DRIVER CIRCUITS

Six hammer driver circuits are contained on the driver board. These circuits receive fire pulses from the logic board and provide energizing signals to the associated print hammer solenoids (L1-L6). Each driver circuit controls one hammer solenoid. A single driver circuit contains a hammer driver hybrid, a switching transistor, a delay adjusting potentiometer, and a fuse. The components associated with each driver circuit are listed in tables 3, 3a and 3b.

NOTE: A loose connection between the logic and driver boards may cause blown 1 amp fuses.

Driver Circuit	Hybrid	Transistor	Pot	Fuse (1 amp)	Resistor	Hammer Solenoid
Receipt Inside	U5	Q5	R19	F4	R18	L1
Receipt Outside	U10	Q10	R29	F1	R28	L2
Journal Inside	U6	Q6	R21	F5	R20	L3
Journal Outside	U8	Q8	R25	F3	R24	L4
Slip Inside	U9	Q9	R27	F2	R26 & R16	L5
Slip Outside	U7	Q7	R23	F6	R22 & R17	L6

Fuse part No. 006-0005453 (wired).

Table 3 Hammer driver circuits (w/o change 29)

Driver Circuit	Hybrid	Transistor	Pot	Fuse (1 amp)	Resistor	Hammer Solenoid
Receipt Inside	U5	Q5	R18	F4	R19	L1
Receipt Outside	U10	Q10	R28	F1	R29	L2
Journal Inside	U6	Q6	R20	F5	R21	L3
Journal Outside	U8	Q8	R24	F3	R25	L4
Slip Inside	U9	Q9	R26	F2	R27 & R16	L5
Slip Outside	U7	Q7	R22	F6	R23 & R17	L6

Fuse part No. 006-0006203.

Table 3a Hammer driver circuits (with change 29)

NOTE: Fuses are eliminated on recently released driver boards.

Driver Circuit	Hybrid	Transistor	Pot	Resistor	Hammer Solenoid
Receipt Inside	U5	Q5	R16	R15	L1
Receipt Outside	U10	Q10	R26	R25	L2
Journal Inside	U6	Q6	R18	R17	L3
Journal Outside	U8	Q8	R22	R21	L4
Slip Inside	U9	Q9	R24	R23	L5
Slip Outside	U7	Q7	R20	R19	L6

Figure 3b Hammer circuits (fuseless)

Each driver circuit is activated by a High (+12 v.) signal being received at its input from the fire control logic of the logic board. For example, when a fire signal is sent to the driver board to cause a print on the journal in one column (16-30), the Journal Outside signal goes High (+12 v.) at J2-26. The High is input to U8, which times out the delay established by R25. After the time-out, Q8 turns ON, providing a current path for +28 v. through F3, J3-20, L4, J3-21, Q8, and R24 to ground. This results in energizing the outside journal hammer solenoid (L4) and printing on the journal. The other driver circuits operate in the same manner; however, the driver circuits used for the slip hammers each contain a resistor which is jumpered in parallel into the firing circuit. One parallel resistor is included for each slip hammer driver circuit. The parallel resistors provide additional drive current when energizing the solenoids, resulting in increased print density.

HAMMER BIAS CIRCUIT

The hammer bias circuit is contained on U4 of the driver board. This circuit provides an inhibit voltage to all hammer driver circuits during the time initial reset is active. During upsequence and downsequence, a High (+12 v.) is applied to U4 from the initial reset signal (TCIR). This results in +3 v. being applied to pin 10 of U5 through U10 which disables the hammer driver circuits.

LOGIC IMPLEMENTATION

The logic operation of the printer consists of loading the data to be printed into the PLB (print line buffer) and then performing a print operation using the parameters established by the format character.

PLB LOADING

The first step in preparing the printer for printing is to load the 30 character PLB. The TCU must receive a ready with slip (RWS) or ready without slip (RWOS) status from the printer before any information is sent from the TCU.

When the printer is ready and the TCU has information for the printer, the TCU sends the accept column address function code (FCADS) to the function recognition logic of the electronic control section. This causes the printer to recognize the next data character as a column address character. The column address character is sent to the printer and is stored in the PLB positioning control logic. This selects an address of one position less than the position of the PLB to be loaded (the PLB shifts before loading).

The TCU sends the accept data character function code (FCDTA) to the function recognition logic, causing the printer to recognize the next data character as a character to be printed. The data character is temporarily stored in the PLB positioning control logic. The PLB shifts one character position. The character is then loaded into the PLB by the PLB loading control logic. The procedure in this paragraph is repeated for each data character in a particular field. An example of the PLB configuration when loaded is shown in figure 17.

	Merchandise Field															Qty Field		Price Field												
COLUMN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
DATA	3	7	5		7	8		8	5	7	4	2				1	1							9		9	0		M	D	S

Figure 17 Print line information

The format character, when received, is sent to the line feed control logic which stores bits 1 through 4, then passes the character on to the mechanism control logic. The mechanism control logic establishes which print station is to be used and tells the hammer fire control logic which print stations are active. During a print operation, the hammer fire control logic may fire only those hammers associated with the print stations specified by the format character.

PRINT OPERATION

After having loaded the PLB and having received the format character, the TCU sends the motor ON function code (FCMON) to the printer. The FCMON function code is received by the function recognition logic and sent to the motor control logic which causes the motor to turn ON. The TCU allows approximately 1 second for the typewheels to be accelerated, then sends the initiate function code (FCPRT) to the printer to start the print cycle. The FCPRT function code is received by the function recognition logic then transferred through the line feed control logic to the mechanism control logic. Once during each revolution of the typewheel shaft (40 msec.) a pulse picked up from the revolution count reluctance head is amplified and sent to the line feed control logic. The line feed control logic transfers the revolution count pulse to the mechanism control logic.

The first revolution count pulse that is received after the FCPRT function causes the mechanism control logic to energize the main clutch solenoid. The mechanism control logic also energizes the solenoids for paper handling according to the format character requirements. For example, if printing is required on journal and receipt, both the journal feed and the receipt feed solenoids are energized. When the end transaction bit is set in the format character, the receipt electro solenoid is energized in addition to the receipt feed solenoid. If printing is required on journal and slip, the journal feed and the slip pressure roll solenoids are energized. The slip pressure roll solenoid is energized at the beginning of a slip transaction and remains energized until the print cycle is completed at the end of the slip transaction. The format character end transaction bit being set during slip printing denotes the end of the slip transaction. The line feed control logic using the format character determines the amount of time the paper feed solenoids are held energized. The amount of time a paper feed solenoid is energized determines the number of lines fed. The slip feed solenoid is energized as the transport mechanism is returning home after having printed on the slip. If a slip is present and printing is not required during the present print cycle, the slip feed solenoid may be energized at the beginning of the print cycle and held energized until the required number of lines have been spaced.

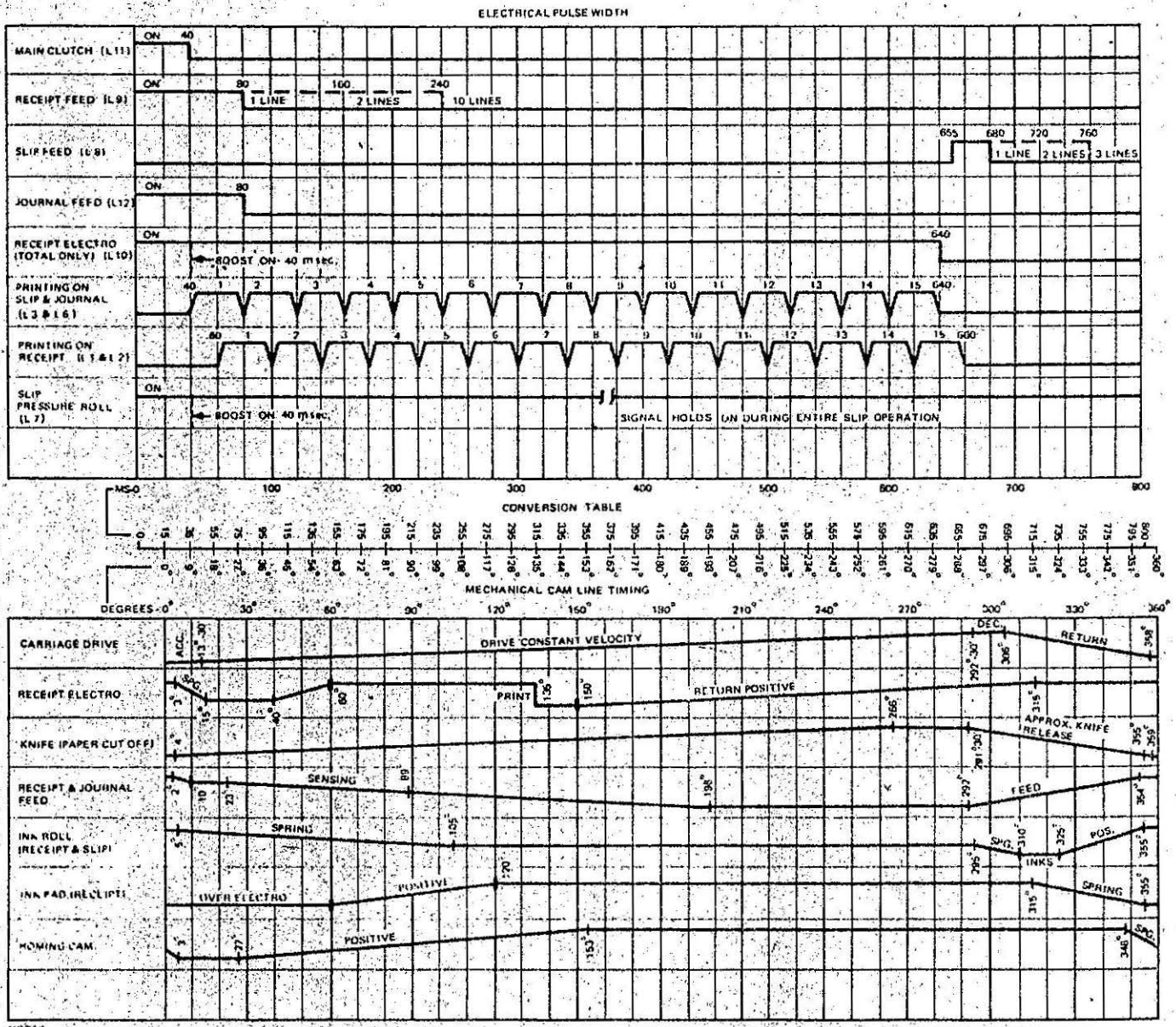
The second revolution count pulse received after the initiate function starts the character generation logic. This sends the code of the first character on the typewheels to the compare logic. The character generation logic receives pulses originating from the character count reluctance head to time each character sent to the compare logic. When the code of the first character on the typewheel is generated (2), the PLB contains the character to be printed in column 1 in the first register and the character for column 16 in the sixteenth register. The characters contained in the first and sixteenth PLB registers are input to the compare logic where they are compared to the code generated by the character generation logic. As the typewheels traverse laterally, the PLB is shifted one position each time a revolution count pulse is received. This results in the characters to be printed in columns 1 through 15 appearing in the first PLB register and the characters to be printed in columns 16 through 30 appearing in the sixteenth PLB register. Each character is present in these two PLB registers for a full revolution of the typewheels. When a character code generated by the character generation logic matches the character contained in either the first or sixteenth PLB register, printing occurs in the proper column. The fire control logic fires the hammers in the print stations selected by the format character. Since the journal and receipt share the same typewheels, it is impossible to print the same character on the two stations at the same time. Because of this, the compare signal for the receipt hammers is routed through receipt hammer delay counter A or B to delay firing the receipt hammers for the 20 msec. it takes for a character to travel the 180 degrees from the journal to the receipt print line.

After printing, the transport mechanism is restored to its home position (left). The printer then sends either a ready with slip (RWS) or ready without slip (RWOS) status code to the TCU.

At this point the TCU may again load the PLB.

TIMING

The relative timing of the electromechanical functions performed by the helical printer during a print cycle are shown in figure 18. The timing involved in the loading of the PLB is not shown due to the fact that between each data character transferred to the printer, the TCU is free to communicate with other modules or units. The helical printer takes approximately 800 msec. to perform a print cycle (one revolution of the cam line) once the main clutch is activated.



NOTES

1. THERE IS A 15 MSEC TIME DELAY FROM THE ENTRY OF INFORMATION IN THE ELECTRICAL PORTION OF THE PRINTER TO THE MECHANICAL TRIP OF THE CAM LINE.
2. THE TYPEWHEEL LINE REVOLVES AT 1500 R.P.M. AND TURNS 20 REVOLUTIONS PER OPERATION. THE CAM LINE REVOLVES AT 75 R.P.M. AND TURNS 1 REVOLUTION PER OPERATION.

Figure 18 Electromechanical timing

PRINTER MODULE PORT CONNECTOR J1

The module port connector for the helical printer is designated M-43-J1 in the C-280 field print package. The lines assigned to the individual pins of this connector are shown in figure 20.

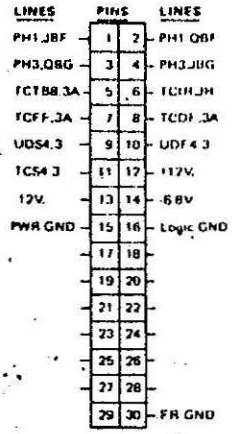


Figure 20 Connector M43-J1

SUMMARY

The helical printer provides the printer record of all transactions performed by the C-280. It provides three 30-column print stations: journal, receipt, and slip. The printing mechanism employs a helical typewheel movement with each typewheel traversing 15 column positions. It contains an electronic section made up of an all MOS board and a hybrid driver board. The printer provides mechanical printing and paper handling mechanisms. It is a common port device controlled by the TCU module.

SERVICE INFORMATION

The service information relating to the helical printer includes the adjustments, preventive maintenance, lubrication information, teardown procedures, and troubleshooting information.

WARNING: Before removing connector J4 from the driver board, unplug the C-280 from the power source. Connector J4 carries 115 v.a.c. from the power supply input to the printer.

ADJUSTMENTS

The helical printer requires certain tests and adjustments be performed to ensure proper operation of the mechanism. These tests and adjustments need to be performed when an adjustment is disturbed by replacing parts during remedial maintenance or when an adjustment of a particular mechanism may remedy a malfunction. The mechanisms requiring adjustment and the procedures for making the adjustments are described in the following.

TIMING BELT

The timing belt provides drive for the typewheel line and the drive line. The adjustment of the timing belt is outlined in the following.

Adjustment

Referring to figure 21, adjust the tension of the timing belt by loosening the hold-down screw. The pull of the spring is sufficient to provide proper belt tensioning. Retighten the hold-down screw. The spring serves no other function, but should be left attached for ease of adjustment.

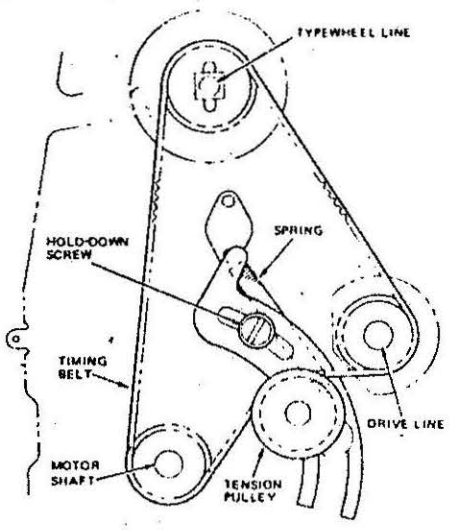


Figure 21 Timing belt adjustment

SLIP FEED

Proper slip feed requires two adjustments, one for the slip feed solenoid and one for the length of slip feed desired for each line (refer to figure 22).

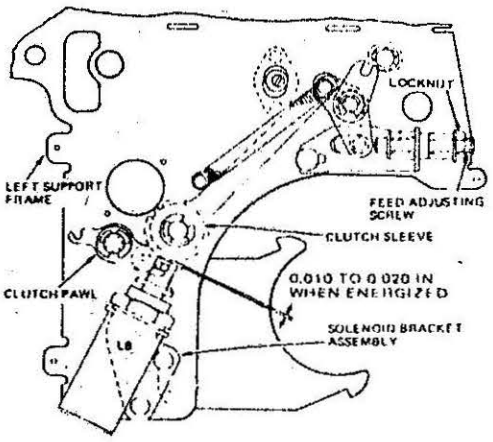


Figure 22 Slip feed adjustment

Slip Feed Solenoid (L8)
Adjustment

Hold the solenoid plunger seated and move the solenoid bracket assembly to a position where the clutch pawl has 0.010- to 0.020-inch clearance under the clutch sleeve.

Slip Feed Adjustment

Loosen the locknut and turn the feed-adjusting screw counterclockwise to decrease the length of feed or clockwise to increase the length of feed. Hold the feed-adjusting screw in position and retighten the locknut.

RECEIPT FEED

Refer to figure 23 when making adjustments to the receipt feed mechanism. Vertical line spacing on the receipt is approximately six lines per inch (0.087 inch maximum, 0.027 inch minimum white space between printed lines).

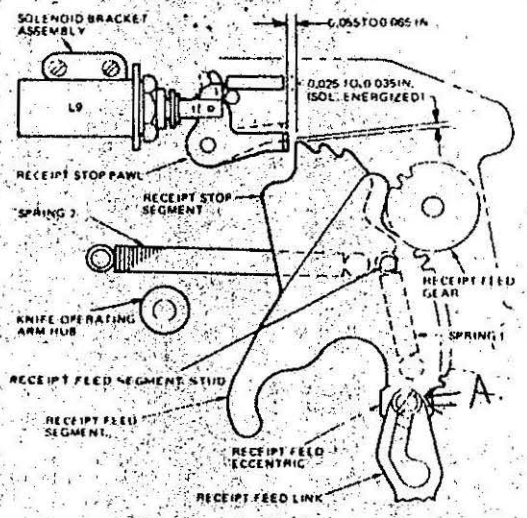


Figure 23 Receipt feed adjustment

Test Procedure

With main clutch tripped, manually operate the printer. The receipt stop segment should move against the receipt stop pawl without moving the receipt feed segment.

If movement is detected, the receipt feed eccentric is not establishing sufficient clearance between the bottom of the slot in the receipt stop segment and the stud in the receipt feed segment. Readjust eccentric as required.

Hold the receipt stop pawl out of the path of the stop segment. Spring 2 must be strong enough to pull the stop segment against the hub of the knife operating arm.

Observe the typewheel drive sleeve as it moves to the right; there should be no interference with the receipt feed link. If there is an interference, turn the eccentric in a direction that carries the feed link away from the typewheel drive sleeve and recheck the above.

Adjustment

With the printer cam line in home position, turn the receipt feed eccentric until the upper extension of the receipt feed segments stops against the receipt feed gear. Continue turning the eccentric, extending spring 1 until the stud in the receipt feed segment transfers from the lower portion of the slot in the receipt stop segment to the top. Back off the eccentric slightly, then tighten in position. This results in 0.055- to 0.065-inch clearance between the receipt stop segment and the receipt stop pawl.

Hold the receipt feed solenoid plunger seated, and position the solenoid bracket assembly so that there is a 0.025- to 0.035-inch clearance between the top of the receipt stop segment teeth and the bottom of the receipt stop pawl.

NOTE: Seat the plunger by applying direct pressure on the plunger and not on the pawl.

RECEIPT ELECTRO

When making adjustments to the receipt electro, the printer should be fully assembled and capable of operating under motor power. Refer to figure 24 when making adjustments.

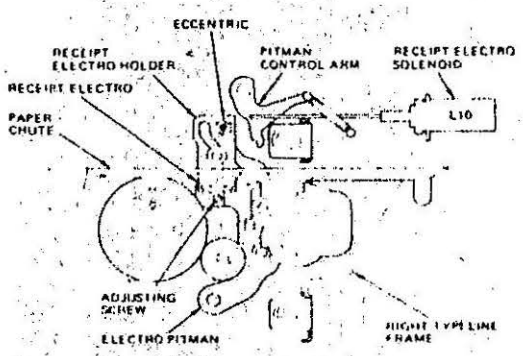


Figure 24 Receipt electro adjustment

Print Adjustment

Step 1 Operate the printer about 10 times by motor, printing the receipt electro each time. Several prints are necessary to ensure that the electro is covered with ink. Examine the electro print to determine if the print is even left to right, or if it is light on either the left or right side. If the print is even, omit step 2 and move to step 3.

Step 2 If the print is light on either the left or right side, it may be adjusted by turning the adjusting screw shown in figure 24. If the print is light on the left, turn the screw counterclockwise. If the print is light on the right side, turn the screw clockwise. Repeat step 1 to determine if further adjustment is necessary.

Step 3 Operate the printer as in step 1. Examine the electro print to determine if the print is even top to bottom, or if it is light on either the top or the bottom. If the print is even, omit step 4 and move on to receipt electro solenoid adjustment.

To adjust Solenoid clearances.
1. adjust solenoid so that pawl clears stop by 25-35 thousandths of an inch. (check for bind)
2. Then adjust eccentric "A" so that pawl is 55-65 thousandths of an in away from stop segment.

Step 4 If the print is light on top or bottom, move the pitman control arm from over the receipt electro holder and operate the printer manually until the receipt electro contacts the paper chute. At this point in the operation, the receipt hammer assembly is out of the way, and the receipt electro holder is up, exposing the eccentric used for adjustment. Remove the eccentric. If the print is light at the top, shift the receipt electro holder top to back. If the print is light at the bottom, shift the receipt electro holder top to the front. Replace the eccentric in a position that will hold the adjustment made on the receipt electo holder. Complete the operation, then repeat step 1 to see if any further adjustment is necessary.

Receipt Electro Solenoid Adjustment

With the receipt electro holder in home position (down), hold in the receipt electro solenoid plunger. Position the solenoid to a point where there is 0.025- to 0.035-inch clearance between the step of the pitman control arm and the upper rear corner of the electro holder.

RECEIPT KNIFE

The receipt knife assembly is adjusted to provide the required clearance when cocking and to provide adequate cutting of the receipt paper during the cutoff operation. Refer to figure 25 when making the following adjustments.

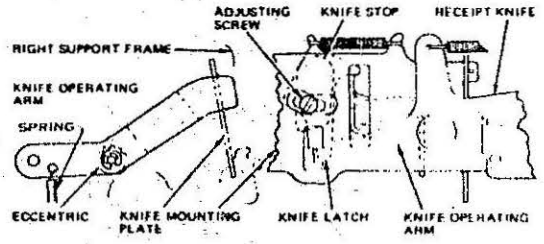


Figure 25 Receipt knife adjustment

Adjustment

Step 1 Manually operate printer until the left end of the receipt knife is moved to its lowest point by the knife operating arm, taking care not to force the receipt knife into the knife mounting plate.

Step 2 Remove the clip and rotate the eccentric until the left end of the receipt knife is approximately 0.015 to 0.060 inch from the bottom of the raceway in the knife mounting plate. Reinstall the clip on the eccentric.

Step 3 Test under motor power to determine that the movement of the knife operating arm is sufficient to move the knife latch from above the knife and permit cutoff.

Step 4 Operate under motor power several times, holding the receipt solenoid plunger in by hand. Observe the amount of the receipt remaining uncut after each operation. Approximately 0.080 to 0.200 inch should remain uncut.

Step 5 To increase the amount left uncut, loosen the adjusting screw and rotate the knife stop counterclockwise. To decrease, rotate the knife stop clockwise.

AUTO RECEIPT FEED SWITCH (S1)

The auto receipt feed switch is wired at its normally closed and common terminals. It is held open in home position by the pressure roll arm (refer to figure 26).

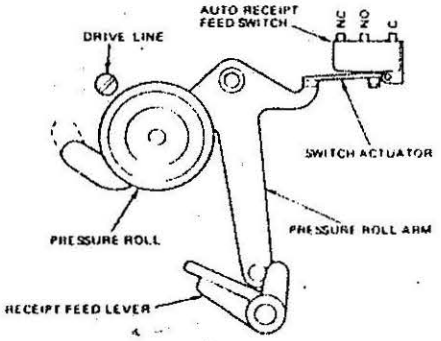


Figure 26 Auto receipt feed switch adjustment

Adjustment

The switch actuator should be formed so that the motor turns ON when the receipt feed lever is pressed.

JOURNAL FEED

When making the following adjustments to the journal feed mechanism, refer to figure 27. Make the receipt feed adjustments prior to the journal feed adjustment to ensure correct location of the receipt feed link. Journal line spacing is approximately six lines per inch (0.087 inch maximum, 0.027 inch minimum white space between printed lines).

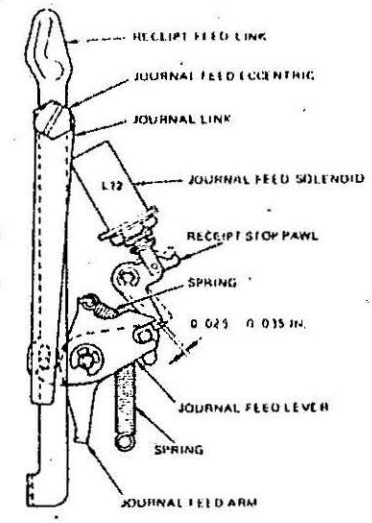


Figure 27 Journal feed adjustment

M43-1-280 HELICAL PRINTER

Test Procedure

Step 1 Manually operate the printer. Observe through the opening in the front plate that sufficient clearance exists to permit the journal feed lever to move down against the receipt stop pawl without moving the journal feed arm. If the above clearance does not exist, perform step 1 of the *Adjustments*.

Step 2 With the journal cassette installed and the receipt feed link in the fully raised position, push in the journal feed solenoid plunger. The lower extension of the journal feed arm should contact the cam surface of the equalizing yoke in the cassette. If the journal feed arm does not contact the camming surface, check for binds or a weak spring.

Adjustment

Step 1 With the cam line in home position, turn the journal feed eccentric until the stud in the journal feed arm is brought against the top of the slot in the right support frame. Continue turning the eccentric until the bottom of the slot in the journal feed lever contacts the stud extending through the support frame. Back off the eccentric slightly, then tighten in position.

Step 2 Holding the journal feed solenoid plunger seated, move the solenoid bracket assembly to a position where there is 0.025- to 0.035-inch clearance as the nose of the journal feed lever moves past the forward extension of the receipt stop pawl.

NOTE: It is important that the plunger is seated by direct pressure applied to the plunger and not to the receipt stop pawl.

Step 3 The spacing between print lines may be varied by adjusting the lower formed extension of the journal feed arm either towards the back to decrease the spacing or towards the front to increase the spacing.

JOURNAL SENSOR SWITCH (S2)

The journal sensor switch, when active, indicates either that the cassette is not installed or the journal supply roll is low. The switch is wired at its normally closed and common terminals. The switch is held open when the cassette is installed and a sufficient supply of journal paper is in the cassette (refer to figure 28).

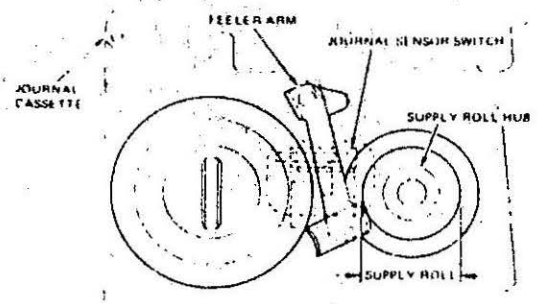


Figure 28 Journal sensor switch adjustment

Adjustment

Place a supply roll in the cassette with a diameter of approximately 1.062 to 1.125 inch. Install the cassette in the printer, holding it to the right against the latch, ensuring that all clearances are at a minimum. Slide the switch bracket horizontally to a position where the switch actuator, in contact with the feeler arm, is moved enough to open the switch. Back off slightly to permit the switch to close, then tighten the bracket. This permits the switch to close under normal operation when 4 or 5 feet of paper remains on the supply roll.

NOTE: Due to the excessive tolerance range of the switch, it may be necessary to form the switch actuator to obtain the proper adjustment.

METERING ROLLS

The metering rolls of the slip, receipt, and journal print stations are adjusted while the typeline is turning. Each metering roll is assembled on an eccentric shaft which has a screw slot in the outside end. Refer to figure 29 when making adjustments on the receipt and journal metering rolls. The adjustment for the slip metering roll is the same but is not pictured.

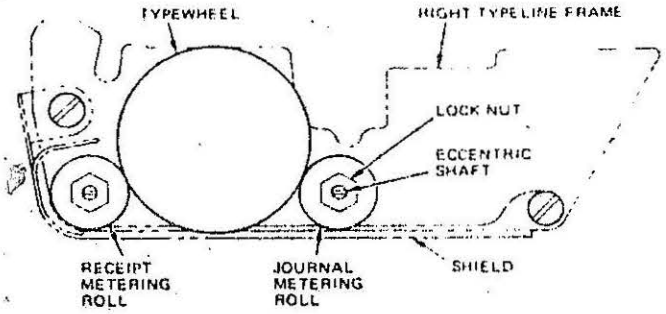


Figure 29 Metering roll adjustment

Adjustment

Begin with the journal and receipt metering roll eccentric shafts turned to give the maximum clearance with the typewheel. Turn the shaft top towards the typewheel center until the metering roll just barely contacts the typewheel and begins to revolve. Turn the shaft 30 to 45 degrees more and lock it in position. To ensure a minimum load on the printer, the adjustment should be made as close to 30 degrees as possible while retaining adequate print quality. Check the clearance between the metering rolls and the shield.

Observe the ink intensity when printing. Adjust the metering roll in towards the typewheel to increase intensity, and away to decrease intensity. Recheck the clearance between the metering rolls and the shield.

INK PAD

When performing ink pad adjustments, refer to figures 30 and 31.

Adjustment

Step 1 Operate the printer manually until the ink pad holder completes its rearward movement (120 degrees of the cam line). Check the clearance between the ink pad holder and the right typeline frame (refer to figure 30). If the clearance is 0.030 to 0.050 inch, omit step 2.

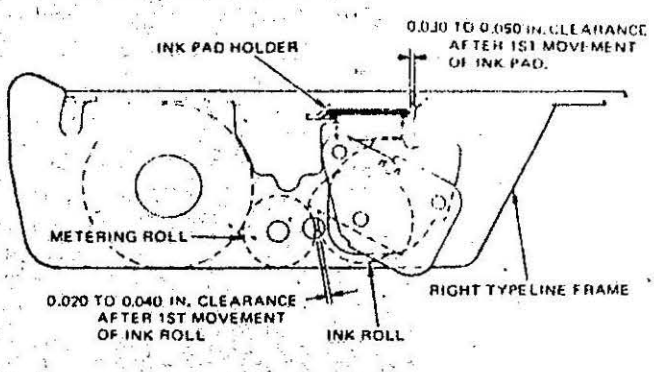

INK PAD HOLDER
0.030 TO 0.050 IN. CLEARANCE AFTER 1ST MOVEMENT OF INK PAD.
METERING ROLL
RIGHT TYPELINE FRAME
0.020 TO 0.040 IN. CLEARANCE AFTER 1ST MOVEMENT OF INK ROLL
INK ROLL

Figure 30 Ink pad and ink roll adjustments

Step 2 If the clearance is found to be greater than 0.050 inch, install a larger roll as shown in figure 31. If the clearance is less than 0.030 inch, install a smaller roll. Change rolls until the 0.030- to 0.050-inch dimension is achieved.

INK ROLL

The metering rolls must be adjusted prior to performing ink roll adjustments. When adjusting the ink rolls, refer to figures 30 and 31.

Adjustment

Step 1 Operate the printer manually until the ink roll has completed its first movement (105 degrees of the cam line). Check the clearance between the ink roll and metering roll through the hole in the right typeline frame (refer to figure 30). If the clearance is 0.020 to 0.040 inch, omit step 2.

Step 2 Remove printer base. If the clearance is found to be greater than 0.040 inch, install a smaller roll as shown in figure 31. If the clearance is less than 0.020-inch, install a larger roll. Change rolls until the 0.020- to 0.040-inch dimension is achieved.

A	DWG. NO.	A	DWG.NO.
0.330	051-0038237	0.3848	051-0007618
0.340	051 0038236	0.390	051-0008109
0.350	051 0008370	0.400	051-0016559
0.360	051-0008209	0.410	051-0016560
0.370	051-0008210	0.420	051-0056817
0.3748	019-0083033	0.430	051-0056816
0.380	051-0008211		

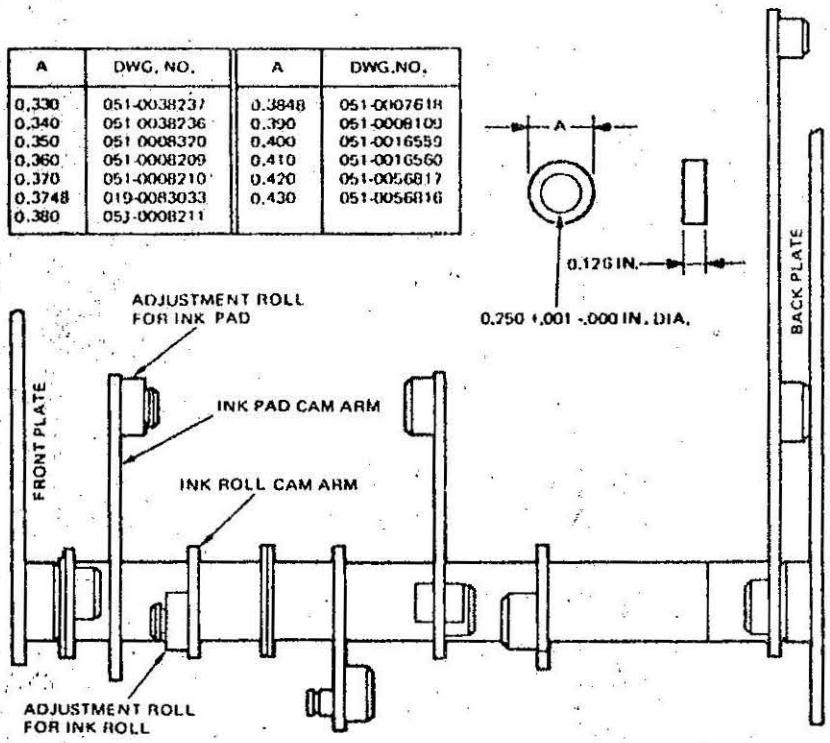


Figure 31 Ink pad and ink roll adjusting rolls

M43-1-280 HELICAL PRINTER

TYPEWHEEL LINE

When making adjustments on the typewheel line, refer to figure 32.

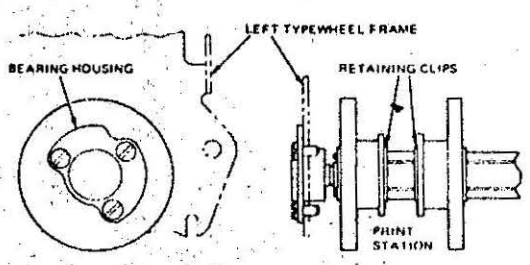


Figure 32 Typewheel line adjustment

Left Typewheel Line Bearing Adjustment

The three screws that mount the bearing housing to the left typewheel frame should be loose when installing the frame. After installing the typewheel line between the support frames, turn the line to permit the bearing housing to seek its own center, then tighten the three screws.

Column Spacing Adjustment

Operate the printer, printing in as many columns of the slip and journal as possible using the diagnostic routine. Observe the spacing between the fifteenth and sixteenth column. If spacing between the fifteenth and sixteenth column is noticeably different from that between other columns, adjustment should be made by shifting the typewheels closer together or farther apart. The following four thicknesses of retaining clips are available for this purpose.

346-0015273- 0.020 inch retainer clip
346-0015695- 0.025 inch retainer clip
346-0016253- 0.030 inch retainer clip
346-0016794- 0.035 inch retainer clip

The end play of individual typewheels assembled on the typewheel line should be held to 0.001 to 0.006 inch. The end play criteria must be upheld after any lateral typewheel adjustment is made.

NOTE: When assembling the typewheels to the typeline, the character "A" should align with the long tooth of the revolution count timing wheel.

SLIP SENSOR SWITCH (S3) ADJUSTMENT

The purpose of the slip sensor switch adjustment is to ensure that slip presence is detected only when a slip is actually inserted in the slip print station. Refer to figure 33 when performing this adjustment.

Test

Hold the ball firmly seated in the dimple of the slip shield. A thickness of 0.025 inch between the switch actuator and the ball should not actuate the switch, but a thickness of 0.040 inch should actuate the switch.

Adjustment

Loosen the switch hold-down screws and position the switch to comply with the criteria of the test. Retighten the switch hold-down screws.

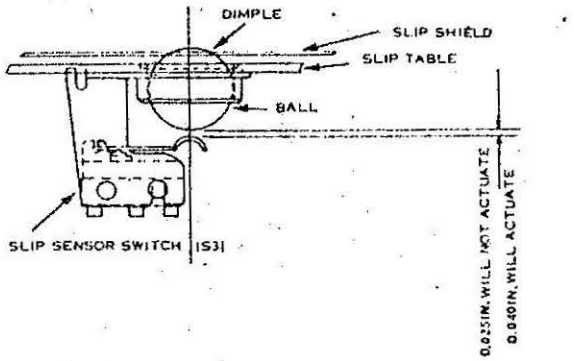


Figure 33 Slip sensor switch adjustment

RELUCTANCE HEADS

The two reluctance heads provide a means of obtaining a coarse adjustment which affects all six printer hammers simultaneously. The electrical printer hammer adjustment provides the fine adjustment for each hammer individually. When making reluctance head adjustments, refer to figures 34 and 37.

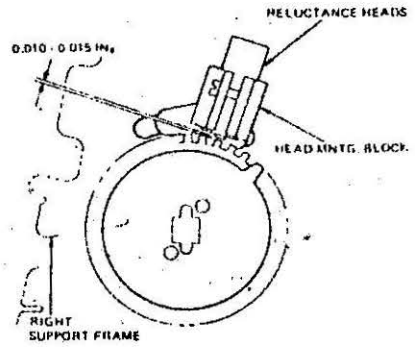


Figure 34 Reluctance head adjustment

Adjustment

Step 1 Set the reluctance heads with a feeler gauge to obtain 0.010- to 0.015-inch clearance above the teeth of the timing wheels and tighten the clamp screws.

Step 2 Adjust R19, R21, R23, R25, R27, and R29 on the driver board to mid range (refer to figure 37).

Step 3 Operate the printer to determine if the same characters input at the keyboard are being printed. If the correct characters are being printed, omit step 4.

Step 4 Move the head mounting block in the radial slot of the left support frame until the proper characters are being printed on the print line, then tighten the mounting block screw.

PRINT HAMMER ADJUSTMENT

The printer hammers are adjusted mechanically and electrically.

Mechanical Adjustment

The hammer assemblies must be adjusted prior to installation in the printer and another adjustment must be made after installation (refer to figure 35).

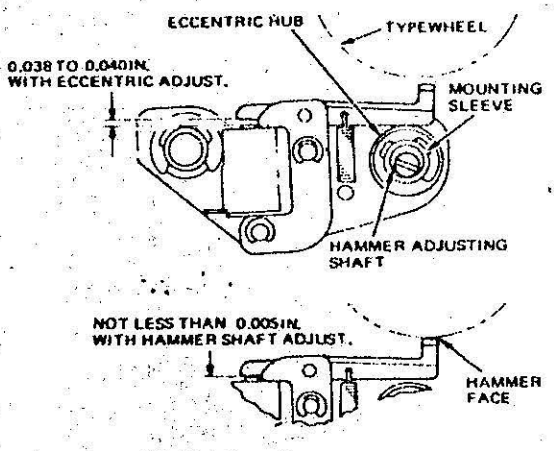


Figure 35 Hammer adjustment (mechanical)

Preinstallation Adjustment

Side Play — Adjust the side play of the hammer assemblies on their mounting sleeves to be between 0.001 and 0.006 inch by selection of either a 0.020- or 0.025-inch retaining clip. Adjust the side play by installing either size clip on the hub side of the sleeves for the receipt and slip hammer assemblies and the frame side for the journal hammer assembly.

Initial Open Air Gap — Adjust the eccentric hub of each hammer to provide a 0.038- to 0.040-inch air gap between the short end of the hammer and the center line of the solenoid core (rough adjustment).

Installed Adjustment

Closed Air Gap — After the hammer assemblies are installed in the printer and the side frames are installed, insert a timing rod through the typewheels to position the typewheels so that a character is flat with respect to the hammer face. Hold the hammer face against the typewheel character and turn the hammer adjusting shaft to give a 0.005-inch air gap between the solenoid core and the short end of the hammer. The second hammer of the pair must also be checked. If the air gap of the second hammer is found to be less than 0.005 inch, the adjusting shaft must be repositioned to set the air gap of the second hammer to 0.005 inch. This increases the gap of the first hammer. All six printer hammers must be checked to have a minimum of 0.005-inch and a maximum of 0.010-inch closed air gap.

Final open air gap adjustment — This adjustment is performed to achieve uniform and sufficient print density between adjacent hammers and to help the minimum hammer recovery time experienced with the 0-2 print combination.

If the print density from adjacent hammers is not the same, the following steps should be taken.

1. Investigate whether the embossing, if any, caused by the hammer producing the higher print density is acceptable.

2. If the embossing is too great, increase the open air gap until the embossing is at an acceptable level and until even intensity between the two hammers is achieved.

3. If no embossing is experienced on either of the two print hammers, then the open air gap of the hammer producing the lighter print should be decreased until equal intensity between the two hammers is evidenced.

When printing the 0-2 combination, the maximum vertical misalignment from character to character should not exceed 0.010 inch (refer to fig. 36). If this requirement cannot be met with the original open air gap setting, readjust open air gap (usually decrease) until print is within vertical alignment specifications. Follow with step 3, if necessary, to achieve even print density between adjacent hammers.

If additional print energy is required to print satisfactorily on the fourth copy of the slip, the open air gap must be reduced until acceptable print quality is achieved on the last copy.

Any adjustments of the open air gap must be followed by the electrical adjustments.

Figure 36 Maximum vertical misalignment

Electrical Adjustment

The print hammers are electrically adjusted to provide vertical print alignment within 0.010 inch for any two adjacent printed characters, and alignment within 0.0[illegible] inch for any two nonadjacent printed characters. Refer to figure 37 when making the electrical adjustments. The potentiometers on the driver board control the hammer firing delay.

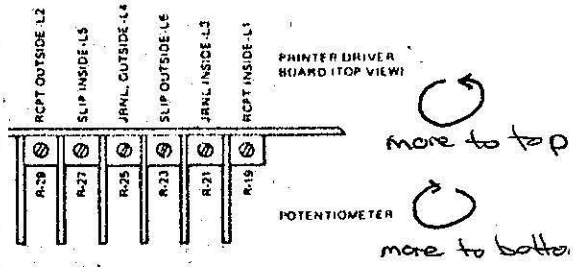
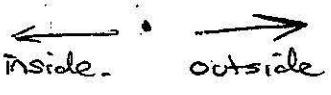


Figure 37 Hammer adjustment (electrical)



M43-1-280 HELICAL PRINTER

NOTE: Prior to performing the following steps, the reluctance head adjustment must be performed.

Step 1 Operate the printer and observe the printing from each of the six printer hammers.

Step 2 If only the bottom half of the characters for a particular hammer are printing, or if the bottom half of the characters are noticeably darker than the top, turn the associated potentiometers clockwise until the full character is being printed. Turn the potentiometers counterclockwise if the top half of a character is printing heavier.

Step 3 Adjust all six printer hammers as outlined in step 2 until no difference is noticeable top to bottom. This is particularly important between the inside and outside hammer of an individual print station.

SLIP TABLE ADJUSTMENT

The left typeline frame is slotted to provide a vertical adjustment for the slip shield (refer to fig. 38).

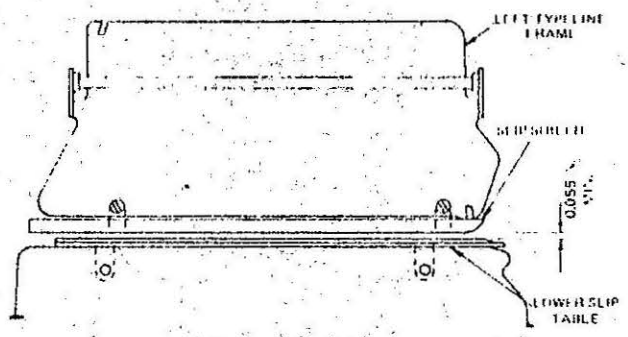


Figure 38 Slip table adjustment

Adjustment

Position the slip shield to achieve a minimum gap of 0.055 inch between the slip shield and the lower slip table. This ensures adequate clearance for multicopy slip insertion.

After positioning the slip shield, visually check for a clearance between the shield and the typewheels and between the shield and the slip feed roll.

CARRIAGE DRIVE ADJUSTMENT

Excessive play between the carriage cam arm and the carriage cams may be eliminated through the application of different diameter cam rolls (refer to figure 39).

Adjustment

Step 1 Manually rotate the cam line until the least amount of loose play is detected. Remove this loose play by installing larger cam rolls, starting with the lead cam roll.

Step 2 Manually operate through a complete 360 degree cam line rotation and determine that no binds have been created. Also, observe that the hammer assemblies are not driven into interference with the side frames.

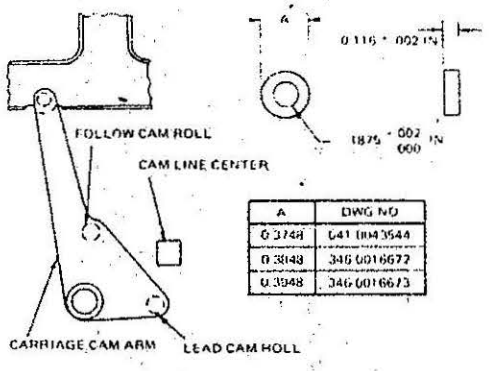


Figure 39 Carriage drive adjustment

MARGIN ADJUSTMENT

The margin at any print station should not be less than 0.030 inch from the first or last column of print to the edge of the paper. This margin is maintained by adjusting the lateral position of the carriage bracket relative to the drive sleeve (refer to figure 40).

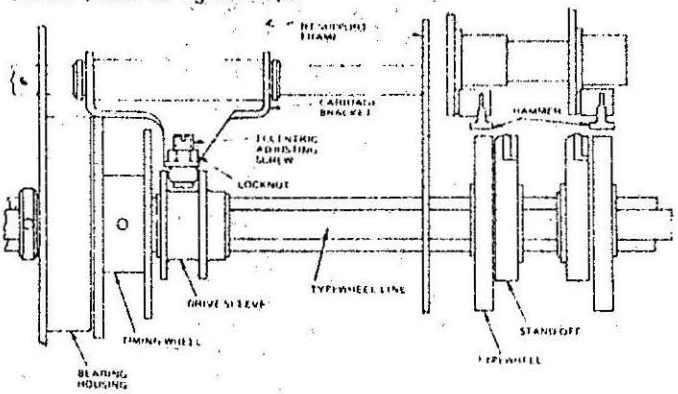


Figure 40 Margin adjustment

The eccentric adjusting screw in the carriage bracket provides lateral adjustment to establish a minimum of 0.030 inch between the last characters printed and the edge of the paper. Accurate adjustment is dependent upon correct paper widths.

PREVENTIVE MAINTENANCE

The helical printer requires preventive maintenance at approximate intervals of 360 days (1 year) or when the C-280 requires printer P.M. Refer to the *C-280-110/111 Retail Terminal Unit Description FSTM,* MS-246, for these requirements.

Clean the paper dust from all areas and remove ink residue with a suitable solvent (chlorothene). The journal cassette and journal shield should be removed from the printer to aid the cleaning task.

NOTE: Prior to removing the journal cassette, turn the journal key clockwise slightly, then release. This action breaks the bond of the roller clutch and affords easier removal of the cassette.

Lubricate the printer with the lubricants specified in the *Lubrication Information* subsection. In areas such as the main drive clutch, slip feed clutch, rolls, and other areas where a disassembly of parts is required to apply the specified NCR lubricant number 801M, substitute with NCR lubricant number 803M.

NOTE: Agitate NCR lubricant number 803M before using.

Lubricate the printer drive motor bearing with medium lubricating oil during preventive maintenance even though the bearings are prelubricated during manufacture.

CAUTION: Do not spray lubricants into the printer because lubricants must not come in contact with the inked surfaces of the following parts.

Typewheel (periphery)
Metering rolls
Ink rolls
Electro
Electro ink pad

Adjust the printer functions when necessary in accordance with the procedures outlined in the *Adjustments*.

Check for worn or broken parts throughout the printer with special attention being given to the following.

Timing belt
Fan drive belt
Metering rolls
Receipt electro
Electro pad slide stop
Timing belt idler pulley
Hammer guide shafts
Receipt knife
Flexible hammer wiring harness
Polyurethane solenoid stop washers

The limited life parts and their life expectancy are listed in the following.

Part	Life Expectancy
Ink roll	1,000,000 print lines
Ink pad	20,000 electro impressions

LUBRICATION INFORMATION

The helical printer contains assemblies that require lubrication during normal preventive maintenance or when installing replacement parts. The following is a list of the recommended lubricants for use on the printer and a list of the lubrication points.

LUBRICANTS REQUIRED

LUBRICANT	STOCK NO.
NCR Lubricant No. 801M (1)	6510801
NCR Lubricant No. 803M (3)	R8655
Medium Lubricating Oil (MLO)	R8593
Gear Lubricant (G.L.)	6510201

LUBRICATION POINTS

Clutch Line	Lubricant
Bearings, Antifriction (prelubricated)	NONE
Bearings, Worm (porous bronze)	MLO
Clutch, Spring (spring, clutching surface); use 801M when the clutch is disassembled and 803M during preventive maintenance.	1 or 3
Gear, Slip Feed Drive (teeth)	1
Housing, Bearing (porous bronze)	MLO
Shaft, Fan (bearing areas)	MLO
Worm (teeth) (lubricate heavily)	G.L.

Drive Motor	Lubricant
During P.M.	MLO

Cam Line	Lubricant
Bearings, Antifriction (prelubricated)	NONE
Cams (cammed surfaces)	1
Gear, Worm (teeth) (lubricate heavily)	G.L.

Cam Arm Line	Lubricant
Arms, Cam (hubs i.d., studs o.d., working surfaces, clipped rolls o.d., i.d.)	3

Metering Rolls	Lubricant
Bearings (porous bronze)	MLO
Shaft (i.d.)	MLO

Typeline	Lubricant
Bearing, Antifriction (prelubricated)	NONE
Gears, Timing	NONE
Hubs, Typewheel (i.d.)	1
Shaft, Typeline (working surface)	1
Shafts, Typewheel Standoff (o.d.)	1
Sleeve, Drive (o.d., i.d.)	1
Standoffs, Typewheel (i.d., working surfaces)	1

Hammer Assemblies	Lubricant
Arms, Hammer (pivot point)	3
Sleeves, Hammer	1

Carriage Drive	Lubricant
Bracket, Carriage Drive (stud, roll o.d., holes)	1
Bracket, Carriage Harness (slot)	1
Shafts (for all stations) (o.d.)	1
Sleeves, Carriage (i.d., working surfaces)	1

Slip Hammer Frame	Lubricant
Bearing, Fan Shaft Support (porous bronze)	MLO
Hub, Slip Feedline (o.d., i.d.)	1

Right Support Frame	Lubricant
Arm, Receipt Knife Operating (hole, hub i.d.)	1
Arm, Receipt Knife Release, (hub i.d., working surfaces)	1
Arm, Journal Feed (stud, working surface, hub i.d.) (lubricate hub very sparingly)	1
Arm, Receipt Pressure Roll (working surface, hub i.d., stud)	1
Arm, Receipt Ink Pad (slot, hub i.d., hold)	
Arm, Receipt Electro Pitman Control (holes, working surface)	1
Chute, Receipt Paper (studs)	1
Chute, Receipt Knife (pivot hole, working surface)	1
Clutches, Receipt Feed Line (spring, working surfaces)	1
Clutch, Journal Feed Arm Roller (prelubricated)	NONE
Frame (all working hubs, i.d., studs, slots)	1
Gear, Receipt Feed (hub i.d., teeth)	1
Knife, Receipt (hole, working surface)	1
Latch, Receipt Knife (working surface, hole, hub i.d.)	1
Lever, Journal Feed (hub i.d., working surface, slot)	1
Lever, Receipt Ink Pad (hole, stud, working surface)	1
Lever, Receipt Ink Roll (hole, stud, working surface)	1
Line, Receipt Pressure (bearing areas, working surface, holes)	1
Line, Receipt Ink Roll (hubs i.d., shafts o.d., slots, compression spring)	1
Link, Receipt Feed (hole, stud o.d., slot)	1
Link, Receipt Knife Operating (hole, slot, stud, working surfaces)	1
Link, Receipt Pressure Roll (holes, hook)	1
Link, Receipt Ink Roll (hole, slot, stud, working surface)	1
Link, Receipt Ink Pad (hole, slot, stud, working surface)	1
Link, Receipt Electro Solenoid (wire) (working surfaces)	1
Link, Receipt Electro (hole, working surfaces)	1
Microswitches (actuator arm and button, working surfaces)	1
Pawl, Receipt Stop (hole, working surface, hub i.d.	1
Pawl, Journal Stop (hole, working surface, hub i.d.)	1
Pitman, Receipt Electro (slots, working surface, stud)	1
Plate, Receipt Knife Mounting (stud, working surface)	1
Roll, Receipt Pressure Drive (hub i.d.)	1
Segment, Receipt Feed (teeth, working surfaces, hub o.d., i.d.)	1
Segment, Receipt Stop (hub i.d., teeth, working surface)	1
Shaft, Receipt Feed Line (bearing area, bearing o.d., i.d.)	1
Shafts, Cassette (o.d.)	1
Slide, Electro Ink Pad (stud, sliding surface)	1
Solenoids (plungers)	NONE
Stop, Receipt Knife (cam surface)	1

Left Support Frame	Lubricant
Arm, Slip Feed (slot hole, stud, hub i.d.)	1
Arm, Tension Pulley (slots, stud)	1
Bracket, Main Drive Solenoid (stud)	1
Cam, Slip Feed Clutch (cam surface, hub i.d., o.d.)	1
Frame (working hubs i.d., studs)	1
Gear, Slip Feed Clutch (teeth, hub i.d., o.d.)	1
Lever, Main Drive Trip (hub, studs, working surface, spring)	1
Link, Main Drive Trip (holes)	1
Pawl, Slip Feed Clutch (hole, slot, hook, working surface)	1
Pitman, Slip Feed (slot, roll o.d., stud)	1
Pitman, Slip Feed (riveted roll, i.d.)	3
Pulley, Tension (hole)	1
Shaft, Slip Feed Clutch (o.d.)	1
Solenoids (plungers)	NONE
Spring, Slip Feed Clutch (o.d.)	1

Journal Cassette	Lubricant
Arm, Feeler (holes, spring o.d.)	1
Frame (bearing holes)	3
Frame (studs)	1
Hub, Receiving Spool (bearing areas o.d., i.d.)	1
Latch, Door (working surface)	1
Lever, Locking (hub i.d., o.d., spring o.d., working surface)	1
Lock, Door (two drops inside keyhole)	3
Roll, Supply (i.d.)	1
Shaft, Journal Feed (hub, bearing area, drive lugs) (Do not lubricate roller clutch portion of shaft)	1
Shaft, Supply Roll (o.d.)	1
Spool, Receiving (i.d.)	1
Spring, Receiving Spool Clutch (o.d.)	1
Spring, Supply Roll (o.d.)	1
Yoke, Equalizer (holes, working surface, spring o.d.)	1

Right Typeline Frame	Lubricant
Bearing, Typeline (porous bronze)	MLO
Frame (hole, stud)	1

M43-1-280 HELICAL PRINTER

7. Install front plate.
8. Install homing spring.
9. Install the fan assembly.
10. Install the qualification panel reflector.
11. Install the printer in the C-280.
12. Apply power to C-280.
13. Operate printer to check print quality.
14. If print quality is poor, perform electrical hammer adjustment.

PROCEDURE FOR REPLACING THE CAM LINE

Removal

1. Printer must be removed from the C-280.
2. Remove homing spring.
3. Remove front plate.
4. Remove springs from cam arms.
5. Remove clip from cam arm shaft, follow up cam arm shaft with a screwdriver, and push shaft to the front.
6. Remove the main clutch.
7. Remove main cam line.

WARNING: Belleville washers compress the cams on the cam line under high pressure; extreme caution should be exercised when removing or replacing cams.

8. Remove and replace cams as necessary.

Replacement

1. Rotate the cam line until the punch mark on the front end of the cam line is up.
2. Rotate the drive line so that the clutch pawl points directly to the front of the printer.
3. Install the cam line into the back plate bearing.
4. At this point a timing rod may be inserted through the back plate through the first cam, indicating correct timing if the clutch pawl is still pointing directly to the front.
5. Replace cam arms and install spring clip.
6. Install springs to cam arms.
7. Replace front plate.
8. Replace main clutch.
9. Replace homing spring.
10. Remove timing rod from cam line.
11. Replace printer in C-280 and test.

PROCEDURE FOR REPLACING A WORN OR BROKEN TIMING BELT

Removal and Replacement

1. Unplug the C-280 from its power source.
2. Remove qualification panel reflector and operator display.
3. Remove printer from unit.
4. Remove the knife assembly.
5. Remove the worn or broken timing belt (cut the belt if necessary).
6. Remove the hold-down screws for the center typewheel line bearing (left support frame).
7. Remove the right typewheel line bearing housing (receipt side).
8. Remove the clip from the slip printer standoff shaft and remove shaft.
9. Loosen the locknut and rotate the slip printer metering roll adjusting shaft away from the typewheels.
10. Manually trip and operate the printer until the typewheel line and center bearing are moved to the right away from the side frames.
11. Install the timing belt around the left end of the typewheel line, the typewheels, typewheel standoffs, and through the slot in the left support frame.
12. Manually operate the printer to the home position and replace the right typewheel line bearing housing, the center typewheel line bearing hold-down screws, and the slip standoff shaft and clip.
13. Remove the fan, main clutch solenoid (L11), slip feed drive gear (see note), and the left drive line bearing.
14. Feed the new timing belt down into the center of the printer and through the bearing hole in the left support frame. Loop the belt around the drive line and back into the center of the printer (use a large spring hook to aid this).
15. Replace the left drive line bearing, slip feed drive gear, main clutch solenoid, and fan assembly.
16. Adjust the timing belt tension.